JUNE

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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Controlling Warpage—*Howard*
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Orthodontics—*Casto*
Odontoclasia—*Simonton-Jones*
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EDITORIALS
What Is Wrong?
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AMERICAN DENTAL ASSOCIATION ORGANIZED 1859 INCORPORATED 1922

THIRTY-FOUR CENTS

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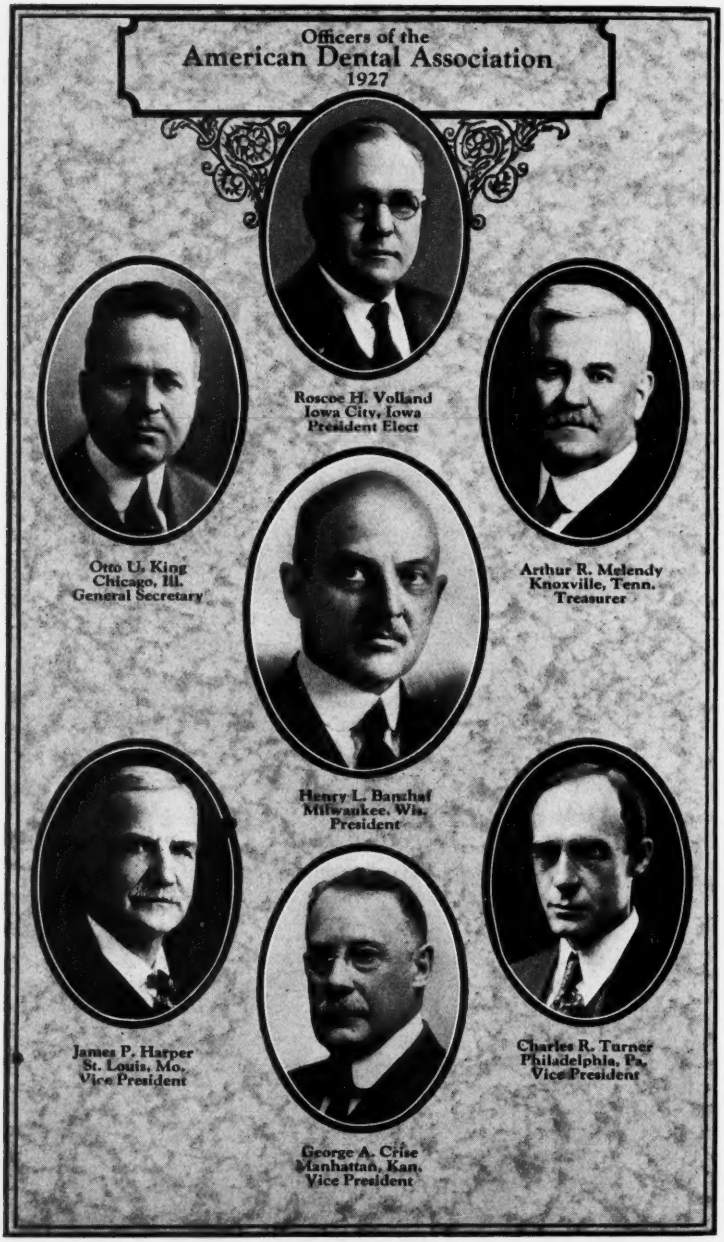

OFFICERS OF THE AMERICAN DENTAL ASSOCIATION, 1927

THE JOURNAL
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VOL. 14 JUNE, 1927 No. 6

Original Communications

CONTROLLING WARPAGE IN CONTINUOUS GUM DENTURES*

By JAMES L. HOWARD, D.D.S., Hollywood, California

IN 1774, according to Guerini's History of Dentistry, Duchateau, a French chemist, started experiments which led to the construction of the first porcelain denture. Duchateau used a paste of some sort of low fusing porcelain, which he shaped over a model of his own mouth, and when the denture was completed, he found that, because of shrinkage in firing, it was much too small. This is an interesting fact because it was the inception of the same trouble that has persisted, in a much diminished degree, however, down to the present time. Since Duchateau's time, porcelain dentures of various kinds have been constructed by a few dentists who have striven for excellence in esthetics. Even within the memory of some of our older practitioners, the all-porcelain denture, formed over a model which had been enlarged in the vain effort to compensate for the subsequent shrinkage through fusing the porcelain, was ingeniously employed in a very limited way. Some of these cases are still in existence and are real works of art, especially when the lack of facilities of these pioneer dentists is considered. On account of the thickness of porcelain necessary to secure strength, and because of the inability to prevent shrinkage and warpage, so that the denture had to be spot-ground to approximately fit the mouth, this method of construction has long since become obsolete. In 1922, C. O. McBean, of Los Angeles, worked on a method of constructing an all-porcelain full den-

*Clinic given before the International Dental Congress in Philadelphia, Pa., Aug. 27, 1926.

ture on a 1 by 1,000 platinum foil base, later stripping the foil out. High fusing porcelain and pinless teeth, held in

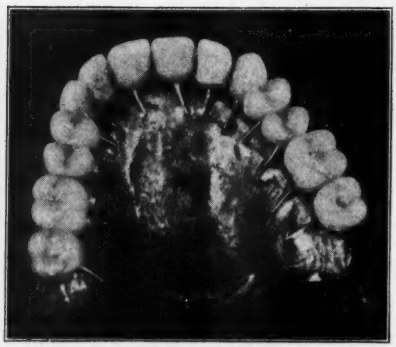

Fig. 1.—Old method of construction.

place by a special high fusing investment of his own, were used. This technic was shown at the American Dental Association session in Cleveland, Ohio, in 1923. It was my privilege to be associated with Dr. McBean while

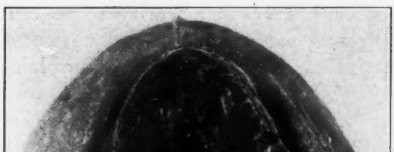

Fig. 2.—Metal die.

he worked on this clinic, and I am indebted to him for many valuable ideas.

The type of construction more commonly used since 1855, when John Allen of New York introduced it, has been the platinum base, with long pin teeth and with porcelain gum, the case being commonly known as "continuous gum." Continuous gum dentures in the hands of experts have been fairly successful, but experts are the exception, while fine dentures should be the rule. Inability of the operator to prevent warpage of the base during the firing process, due to shrinkage of the porcelain and subsequent impracticable means of correcting warpage, has made this tech-

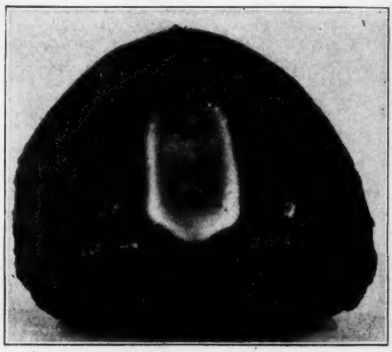

Fig. 3.—Small counterdie in metal die.

nic so hazardous that it is seldom recommended to the patient. In following the usual technic of the past, as soon as the platinum base was completed, especially constructed long-pin teeth were set up and soldered to the base (Fig. 1). This operation alone usually warped the base more or less, and the subsequent layers of porcelain increased the distortion in inverse proportion to the skill and luck of the operator.

Many porcelain workers have realized the short comings of this old technic and tried in various ways to overcome it. In 1922, V. C. Smedley, of Denver, showed, at the American Dental

Association in Los Angeles, a method of holding the teeth with an alundum cement investment while firing the porcelain, his idea being to prevent movement of the teeth.

P. A. Kanouse, of the Kanouse Dental Laboratory of Los Angeles, got a little closer to the solution of the problem by swaging his cases between firings. He used the old method of construction (long-pin teeth soldered to the base), which made his technic impractical because the teeth occupied so much space on the base that direct force could not be applied and because there was danger of displacing or breaking off the teeth.

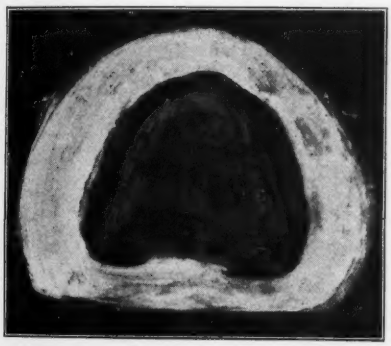

Fig. 4.—Master cast seated in plaster.

The technic that I am now using was first shown at the Southern California State Dental Association meeting in Los Angeles, June 1, 1926, and next at the Pacific Coast Dental Conference in Portland, Ore., June 22 and 23, 1926, by P. C. Tennis and me. I then took it to the International Dental Congress in Philadelphia, Aug. 27, 1926, Dr. Tennis being unable to attend.

Our clinics given together were developed individually, and while they were similar in many respects, in certain essentials, they were quite different.[1]

Following is a description of my technic, in which I call especial attention to the use of pinless teeth and the control or warpage at all times by swaging.

A good muscle-trimmed impression is taken and a model of stone is poured. After properly relieving the model, a mold is made of calcar or of sand and plaster, into which is poured Babbitt's metal, "dialoy" or some other suitable metal, making a replica of the stone model or a die (Fig. 2). The die is coated with carbon from a burning match or piece of vulcanite, and metal is poured into the palatal portion (Fig. 3), making a small counterdie the use of which aids materially in forcing the platinum to place in the vault and holds it firmly in position while the ridge and peripheral portions are being adapted. The stone model is now seated in plaster of Paris in the

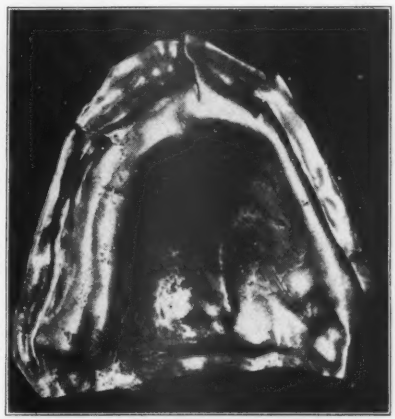

Fig. 5.—Platinum base started.

1. Compare Tennis, P. C.: Am. Dent. Surgeon, November, 1926.

lower half of a vulcanizing flask, which has been oiled to facilitate removal (Fig. 4).

Tin foil No. 60 is burnished over the die and trimmed to size in order to obtain a pattern for the platinum base, and another piece is formed for the doubler across the posterior border. Pure platinum, 30 gage for an average case, is used, and the work of adapting and swaging to the die is begun. The platinum plate is slit in the region of each cuspid and at the median line from the periphery to the crest of the ridge (Fig. 5). V-shaped pieces should not be cut out but should be allowed to overlap. These are later soldered, and together with the doubler across the posterior border, and the turned rim, add greatly to the strength, as a rule constituting the only metal reinforcement necessary. The soft platinum is pressed with the fingers, tapped with a horn mallet and forced to place with the counterdie, until it is approximately adapted to the die, when it is removed, boiled in acid and annealed (preferably in an electric furnace), then replaced on the die and swaged. After being removed from the swager, and again cleaned with acid and annealed, it is replaced on the die and wrinkles are worked out with the horn mallet. Cleaning, trimming, annealing and swaging—these four operations are repeated until a good adaptation to the die is secured.

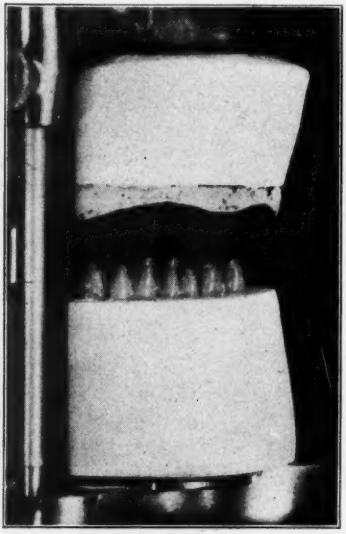

Fig. 6.—Waxed up case.

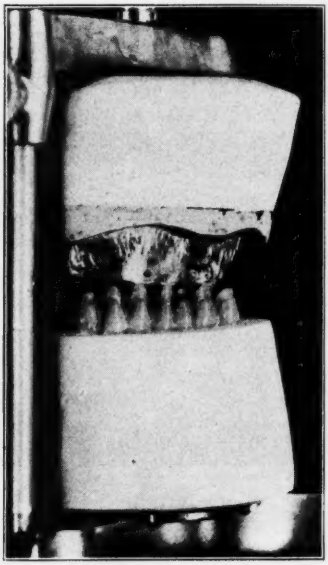

Fig. 7.—Wax removed.

Since the die may have become sprung from hammering and swaging, the base should be swaged once on the stone model (Fig. 4), which is the master cast.

We are now ready to take the bite and facebow relationship, using the platinum base for our baseplate. The case is mounted on a good anatomic articulator, and teeth selected are set up and then tried in the mouth. The teeth used should be any of the high fusing pinless variety or high fusing

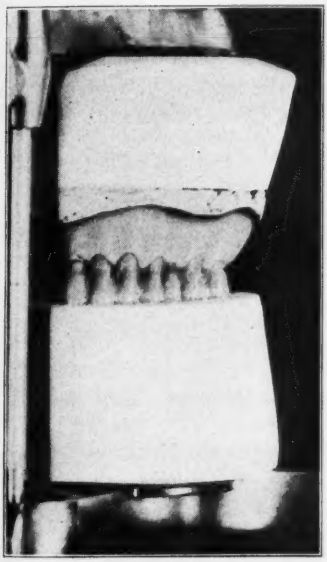

Fig. 8.—Porcelain built down to teeth.

teeth made for vulcanite work, provided the pins are removed. In fact, there may be any of a variety of teeth used, as long as the fusing point is above 2,300 degrees, and there are no pins.

If the try-in proves satisfactory, we proceed with the next step, that of mounting the waxed-up denture in another articulator having a definite incisal stop or pin. At this time, we are not concerned with any movement of the articulator other than the opening and closing, which must be very definite. (The articulation has been previously established.) The mounting is accomplished by pouring some plaster on the lower bow of the articulator, building it up to a little less than half way and leveling off the top, and then carefully centering the waxed-up denture and

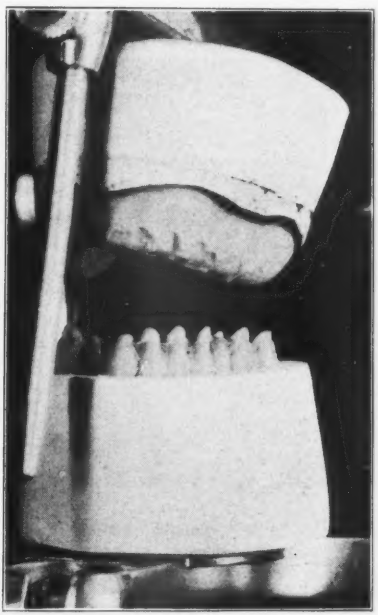

Fig. 9.—Indentations in porcelain made by teeth.

seating the teeth in soft plaster to the full depth of the cusps and incisal edges. When they are set, the operation is completed by filling the platinum base with plaster and building it up to engage the upper bow of the closed articulator (Fig. 6). After the plaster has hardened, the wax which attaches the teeth to the base is warmed over a bunsen flame and removed, leaving the teeth seated in the plaster below, and the base at-

tached to the upper bow of the articulator (Fig. 7). We now have a chance to visualize the amount of porcelain body, and the approximate number of firings that will be required to attach the teeth to the base and secure proper fulness and contour.

The platinum base is now removed from the articulator and the first layer

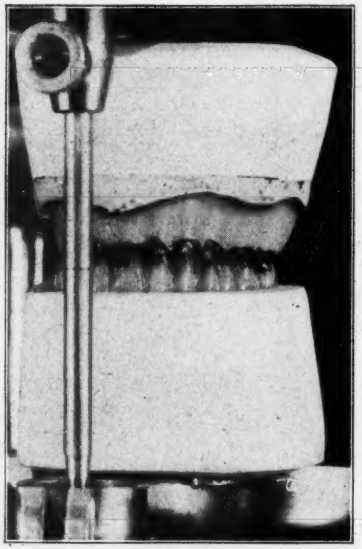

Fig. 10.—Teeth waxed to base.

of porcelain body is applied. It is suggested that a porcelain of a higher fusing temperature than has been customarily used should be employed here. Any good grade of porcelain fusing around 2300 degrees may be used. The first application should consist of little more than is sufficient to well fill the periphery and the raised anterior edge of the doubler, great care being taken to condense the porcelain thoroughly so that no porosity may occur to be ground into later, should it be necessary to trim the periphery.

The base is now placed in the furnace

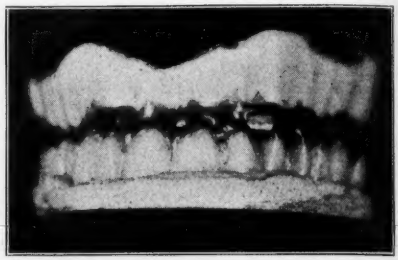

Fig. 11.—Teeth pressed into alundum cement.

and fired to a high biscuit. Specific temperatures are misleading because of the variation in furnaces and pyrometers, but the result should be just short of a glaze. After removal from the furnace, the base is tried on the master cast and, protecting the porcelain with

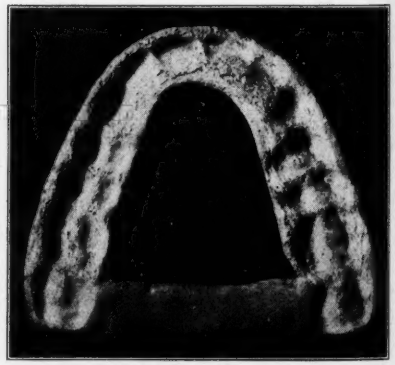

Fig. 12.—Alundum cement matrix.

a piece of rubber dam, it is put in the swager and driven to place on the stone (master) cast. This may slightly check the porcelain, but this is immaterial, as

the cracks will be filled in and fused together at the next firing.

A second layer of porcelain is applied, this time completely covering the base with a rather thin layer. As greater skill is acquired, the technic may be shortened and greater speed will naturally be developed. After each layer is applied, and before firing, the base is placed in the articulator and the instrument closed to ascertain how near the porcelain is to the teeth. If any of the teeth should touch the unfused porcelain, the articulator should be

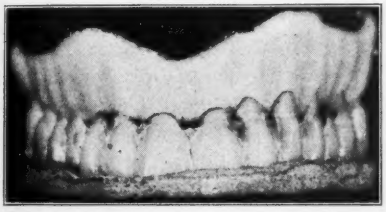

Fig. 13.—Fused porcelain base seated on teeth ready to be attached with porcelain.

tightly closed until the incisal guide pin is seated. This will give an impression of the necks of the teeth in the moist freshly applied porcelain.

Again the case is fired and, after cooling, it is tried on the master cast and swaged.

The number of firings depends on the length of the bite, the object being to build the porcelain body down to the teeth. We will assume that this is an average case, and that the third layer brings the porcelain well down around the gingival ends of the teeth. To accomplish this, when the third layer of porcelain is being applied, a slight excess is placed where the teeth will strike it, the base is placed in the articulator, and force is again applied until the incisal pin is seated (Fig. 8). When the articulator is opened, there will be fourteen indentations or facets in the porcelain (Fig. 9), which correspond to the fourteen teeth. The base is carefully removed and again fired to a high biscuit. After removal from the furnace, it is tested for warpage by being placed on the master cast. If the technic has been carefully followed,

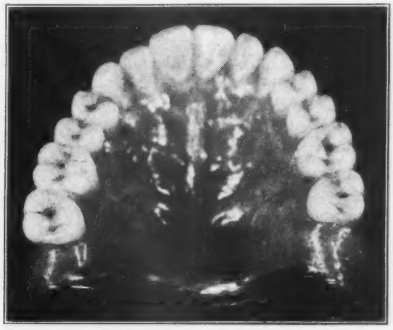

Fig. 14.—Finished denture.

there should be little or no change after the first or second firing, but if there is any, it should be swaged again. Now the base is placed in the articulator and closed. Each tooth should fit into its corresponding depression in the porcelain, and the incisal guide pin should be completely seated.

The teeth are now waxed securely to the base with sticky wax (Fig. 10), and on opening the articulator, they are released from their occlusal seat in the plaster. The base, with teeth waxed to it, is also removed from the articulator. The next step is to attach the teeth with porcelain.

Alundum cement is mixed to the consistency of thick putty, and a layer three-eighths inch wide by an eighth inch thick is laid down on a flat piece of metal or smooth asbestos board and shaped to the size and form of the occlusal arch, connecting the ends in the region of the second molars. The base, with teeth waxed in place, is seated on this alundum cement and slight pressure is exerted until the teeth sink into the cement approximately a sixteenth inch (Fig. 11). The teeth are given a coat of thick shellac before being seated in the alundum cement to facilitate removal. The case is now placed over a gas fire and slowly heated. As soon as the wax becomes warm, the base may be removed, the teeth being left seated in the alundum matrix. More heat is gradually applied until the alundum cement becomes red hot. Now it is allowed to cool. When it is cold, the matrix will be quite hard and rigid (Fig. 12). The platinum-porcelain base is now seated on the teeth, which are held in place in the alundum matrix. This is easily accomplished, as each tooth fits into its individual impression in the porcelain base (Fig. 13).

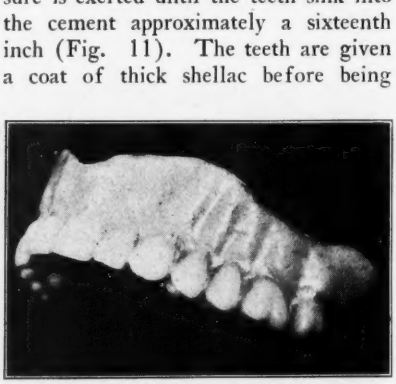

Fig. 15.—Completed case.

Up to this time, we have used medium fusing or 2,300 degree porcelain. We are now preparing to attach the teeth to the base, after which it is impossible to again swage the plate. Therefore, if we cannot correct a mistake, it behooves us to avoid making one. From now on, we use a porcelain with a lower fusing point. With the teeth held securely by the alundum cement matrix occlusally, and by the platinum-porcelain base gingivally, we pack porcelain that fuses at about 2,100 degrees around the necks, and condense well. This time, it is placed in the furnace, occlusion downward, resting in the alundum matrix, and fired at approximately 200 degrees less than previously. By firing at a lower temperature the higher fusing porcelain previously used is not affected; therefore, the base is held rigidly and there is no chance of its warping. Obviously, there is no necessity for swaging from now on.

The teeth being securely attached, we turn our attention to the final layer of body, or 2,100 degree porcelain, building to proper contour, festooning and carving in the rugae. This is fired as before, the teeth resting in the alundum cement matrix. We are now ready for our final layer, that of pink enamel. For this layer, we use a still lower fusing porcelain, one which fuses at approximately 2,000 degrees.

This finishes the firing technic, and after the platinum base is polished and the occlusion milled in, the case is completed (Figs. 14 and 15).

The advantage of this technic over previous methods of constructing continuous gum dentures may be summed up as follows:

1. By the use of higher fusing porcelain, we obtain greater strength,

thereby lessening the necessity for iridio-platinum wire trusses and doublers.

2. The porcelain, being higher fusing, is less liable to fracture; but should breakage occur, it is easier to repair.

3. The porcelain is finer and permits of easier manipulation, with much greater resultant density. This permits grinding through the platinum base periphery, if it becomes necessary, without exposing a mass of bubbles.

4. Stock teeth of a great variety and selection may be used instead of the one variety of long platinum pin teeth, which had to be ordered "special" from the factory at excessive cost and much delay.

5. The teeth are not subjected to repeated high temperatures; therefore, they do not become overfused and brittle as they did with other technics.

6. Warpage of the platinum base is absolutely controlled, this insuring a denture that will fit.

7. The technic is simple and more accurate, and permits of a great saving of time in construction.

I believe that this technic so nearly eliminates the difficulties of continuous gum denture construction that this most artistic phase of dentistry will become as practical, with the average dentist, as the construction of a good gold denture or a jacket crown, and it should be the means of placing the best denture service within the reach of those of moderate means instead of its being a luxury that only the rich can afford.

ELECTROTHERMIC METHODS APPLICABLE TO THE MOUTH, WITH SPECIAL REFERENCE TO NEOPLASIS*

By WILLIAM L. CLARK, M.D., Philadelphia, Pennsylvania

ELECTROTHERMIC methods have a definite field of usefulness in the treatment of neoplastic and allied diseases within the mouth. One who depends on any single method, however, may hope to attain but a limited degree of success.

Experience has taught that operative surgery, electrothermic methods, radium and roentgen rays are all factors of such importance that none of them can be eliminated. All these are employed in our hospital, either alone or in combination, to meet particular indications, and if it became necessary to eliminate any one of them, we would be seriously handicapped. We hold no brief for any particular method, but experience has demonstrated the extreme importance of electrothermic methods, which, through a misunderstanding of them, have not yet taken their rightful place, particularly in oral surgical practice. We consider them second to none, and, in many emergencies, superior to all the others. It is the desire to emphasize the importance of electrothermic methods, without detracting from the others, devoting this paper to a discussion of the rationale, instrumentation, technic, clinical observations and histologic findings, with indications for and contraindications to their employment. The types of cases in which these methods stand supreme will be stressed, and a sound basis for their employment will be demonstrated, with the hope of encouraging serious consideration of their unique advantages.

*Read before the American Society of Oral Surgeons, and Exodontists, Philadelphia, Pa., Aug. 20, 1926.

ELECTROTHERMIC METHODS

Two tissue changes produced by high frequency currents will be considered. These are classified descriptively, in accordance with the actual effects produced in the tissues, as desiccation and coagulation.

The Desiccation Method.—The desiccation method is one by means of which benign and malignant growths of small or moderate size may be destroyed by the utilization of heat of just sufficient intensity to desiccate or dehydrate the tissue. The heat is produced by a monopolar high frequency current of the Oudin type, the current being conducted to the lesions by means of a steel needle or other pointed metallic applicator. A single spark gap is usually employed in the circuit, although a multiple gap that is subject to refined regulation may be used. The desiccation effect, as originally described by me, was produced by a high tension static current, transformed into a high fre-

quency current of suitable quality, by means of Leyden jars of proper capacity and a resonator supplying the correct induction. Since the advent of the modern transformer type of high frequency machine, it has been shown that desiccation can be satisfactorily produced with the latter apparatus.

There is an impression among many of the profession that the desiccation and coagulation methods are one and the same. This is an error, since the effects produced on the tissues are quite different and can readily be demonstrated both clinically and histologically. The Oudin current, by which desiccation is produced, is of relatively high voltage and low amperage; whereas, the d'Arsonval current, by which coagulation is produced, is of lower voltage and higher amperage.

A milliampere meter cannot be used to measure accurately a monopolar current. The proper current strength necessary to destroy growths of different types and sizes within the mouth can be learned only by experience. The desiccation effect may be produced in the tissues by delivering the current through a short air space, by just touching the surface or by inserting a needle more or less deeply, according to the degree of destruction desired.

The desiccation method is used advantageously when the lesion is comparatively superficial and localized, and when it is desirable to avoid a contracted cicatrix. It is subject to such perfect control that an exceedingly small growth, even on the cornea, can be successfully treated without impairment of vision by the subsequent formation of scar tissue. A small growth on the vocal cords may likewise be destroyed without impairing the voice. It will thus be seen that this method can be employed advantageously in the treatment of such lesions in the mouth as leukoplakias, papillomas, angiomas, Vincent's infection or other localized infections, lupus vulgaris, exostoses, epulis, sarcoma, localized epitheliomas, etc. The comparatively slight trauma to the tissues and the mild secondary inflammation explain, from a histologic standpoint, the slight scarring and the success obtained in treating delicate structures.

The Coagulation Method.—Coagulation is produced by a bipolar high frequency current of the d'Arsonval type, a multiple spark gap being employed. It is more penetrating and intense than the desiccation method, and in accessible locations is utilized to destroy larger growths, even those involving bone.

There are many variations of technic in the application of this method to suit the requirements of the individual case. These cannot very well be described, but must be learned from practical experience. The active electrode should always be pointed. Steel sewing needles of various lengths may be employed. If still greater length is desired, metallic knitting needles or stiff wire cut to any length may be used, either straight or curved, so as to be adapted to particular anatomic locations. Since the effect of high frequency currents is entirely thermic and not electrolytic, it does not matter what particular metal is used. As it is impossible to insulate these electrodes thoroughly, care must be taken that only such tissues as are undergoing treatment shall be touched. The indifferent electrode that is necessary in this method may be of any material that will conduct electricity, such as a

bare metallic plate, or, preferably, a moistened asbestos pad covered with a metallic plate or wire mesh, and bound together with heavy cloth, such as linen or duck. This should be placed in close contact with the skin of the patient's back. Both the active and the indifferent electrodes are connected, by insulated wires, to either side of the d'Arsonval winding of the high frequency machine. Good contact in all the circuit connections is of great importance. A meter should be connected in this circuit as a guide to the current strength employed, which varies from about 200 to 2,500 milliamperes, according to the size of the growth to be treated. The meter is not an infallible guide in estimating the action of the current, since the reading is also influenced by the size of the patient under treatment, or, in other words, by the amount of resistance in the circuit.

Doyen's method of coagulation consisted in the use of a blunt metallic electrode applied directly on the growth, and another of the same or larger size at some point near the growth. It has been shown that the control by this technic is imperfect, and experience has taught that the pointed active and the large passive electrode offer a superior method of application. While the current is passing, the needles may either touch the surface of the growth or be inserted into it, this depending on the depth of destruction desired. In pedunculated growths, a metal snare may be used to advantage as the active electrode. As already stated, the d'Arsonval current, by which coagulation is produced, is of relatively low voltage and high amperage. If a short air space intervenes between the growth and the needle, the current will be conducted to the tissue in the form of convective sparks, which sometimes approach the intensity of a flame, this depending on the frequency of the oscillations in the current. Under such conditions, the coagulation will be superficial. On the other hand, if the active electrode remains in close contact with the growth, heat will be generated in the tissues without the production of sparks. Under these conditions, the tissues will be deeply coagulated, the actual depth depending on the duration of the application. Better control of coagulation can be acquired by inserting the needle into the tissues to the desired depth, and thus shortening the treatment period. Unlike the heat generated by these high frequency currents, which penetrates deeply into the tissues, that produced by the actual cautery is comparatively superficial in action. The former is generated within the tissues by their resistance to the current, while the latter is merely transmitted by contact. Whether the desiccation or coagulation method is employed, the aim should be to destroy the growth at a single operation.

In lesions of the body surface, the devitalized tissues should, as a rule, be removed immediately either by excision or curettage, which usually may be accomplished without hemorrhage. If necessary, the base may then receive further treatment. Excision or curettage following electrothermic treatment is practiced less frequently in lesions within the mouth than upon the skin surface owing to the greater danger of secondary hemorrhage, because of maceration of the tissues by secretions. Therefore, with certain exceptions, the destroyed tissue is allowed to separate slowly. Bone that has been

treated will sequestrate in about six weeks, if a current of sufficient intensity has been employed.

In dealing with localized benign or malignant lesions, the superiority of the electrothermic methods over irradiation is shown by definite histologic changes and by comparison of permanent clinical results. With electrothermic methods, only diseased tissue is destroyed, the vitality of the surrounding normal structures being conserved. Subsequent treatments, should they be necessary, offer as good prospects of success as though the tissue had not received previous treatment. On the other hand, with irradiation of such intensity to influence a malignant growth, it is impossible not to lower the vitality of the surrounding normal tissue to a certain extent. In case of recurrence, little more can be hoped for from further irradiation, owing to the resulting fibrous changes. This is a fact well known to radiologists. Because of these resulting changes, irradiation should not be used in conjunction with electrothermic methods in distinctively localized benign or malignant lesions within the mouth. There are many cases in which the electrothermic methods are not applicable and in which irradiation is preferable, but our experience has been such that we feel very strongly that the electrothermic methods alone should be used in the type of lesion mentioned. Electrothermic methods are strongly contraindicated in extensive lesions that cannot all be destroyed with one operation. If any of the disease is left, it will usually be stimulated to greater activity. If vital structures are involved, irradiation is preferred to electrothermic methods. It is necessary to treat the lymphatic drainage areas in the neck by radium, roentgen ray or a combination of both to inhibit or destroy malignant cells migrating to the glands, or to destroy the pathologic element, if metastasis is already apparent.

High frequency machines, as devised by different manufacturers, vary greatly in construction; hence, there is a corresponding variety in the quality of the currents produced. The thermic intensity is often too great or too little, and an undesirable faradic effect, producing shock and contraction of the tissues, is expected when the improperly constructed machines are used. This lack of standardization is unfortunate, since, to produce the desiccation effect under the best conditions, an accurate balance must be maintained between voltage and amperage, and also between capacity, induction and resistance. Thus, different operators, employing various types of apparatus, may obtain different results. A machine giving a satisfactory therapeutic current may not be suitable for surgical work. We have found it necessary to have machines constructed according to definite specifications in order to obtain the various features necessary for our particular requirements. Even with a machine constructed on correct lines, there is difficulty of application, principally in the acquirement of a proper technic. Much harm can be done by an operator without practical knowledge of the various factors involved. This warning seems appropriate since a considerable number of cases come under our observation that have been improperly treated with high frequency currents.

We have heard these methods condemned by capable surgeons who have employed them, but on studying their

technic, it has been easy to see the reason for dissatisfaction with the results obtained. One who studies these methods carefully cannot fail to be impressed with their merits.

Electrothermic methods can be best practiced only by those who have had surgical training and experience. They are quite as surgical in practical application as operative surgery, requiring the same knowledge of anatomic landmarks and the same surgical judgment that every good operator must have. The probable reason for the apathy that exists in regard to these methods is that surgeons do not realize their potency, and that those who use them without surgical accomplishments frequently fail in their practical application. Electrothermic methods are peculiarly adapted to treatment of localized malignant growths occurring in any part of the oral cavity. The efficiency of these methods is, in certain cases, increased by the combination of operative surgery, radium and roentgen rays. Electrothermic methods should be used alone only in localized tumors of a type that does not tend to metastasize. The basal cell type of epithelioma occurring on cutaneous surfaces, such as the face and eyelids, even though extensive and with involvement of bone, may be so thoroughly treated by the desiccation or coagulation method that recurrences are infrequent.

In localized squamous cell epitheliomas on cutaneous surfaces or mucous membranes, the results are almost as good as in the basal cell type. When the growth is no longer localized and metastasis has occurred, it is again emphasized that other methods must be used in addition. The choice between local or general anesthesia is governed by the same principles as in operative surgery.

As an example of an operation by the coagulation method, amputation of the tongue is here described.

AMPUTATION OF THE TONGUE

If the case is far advanced, with considerable general emaciation, it is our practice to perform a preliminary gastrostomy. This also applies to extensive lesions, located anywhere in the mouth or throat, that render deglutition difficult. The operation of gastrostomy may be performed under local anesthesia, with little hazard to the patient. This has several advantages; permitting the building up of the patient's strength, relieving the pain incident to swallowing, and frequently resulting in a considerable reduction of swelling and induration in the tongue and pharynx following the rest given to these parts. The tongue can be coagulated readily through its base and then excised, with infrequent secondary hemorrhage; but to obviate this danger completely, it is considered safer to ligate the lingual as a preliminary measure, or, if deemed prudent, one or both of the external carotid arteries. Ether anethesia is employed. The ether should be removed from the room when the patient is fully under its influence and before the current is applied, else it might ignite. Should the operation be unusually prolonged and the patient show signs of regaining consciousness, the operation may be temporarily discontinued as often as required, and ether again administered. Ordinarily, this operation is of such short duration that the use of ether a second time is not necessary. Scopolamin, one one-hundredth grain (0.6 mg.), and morphin one-fourth grain (16 mg.), may, in some instances, be used hypodermically one hour before the administration of ether. Less ether will be necessary under such conditions, and the immediate postoperative discomfort will be minimized.

After the jaws have been separated with a mouth gag, a heavy silk suture is passed from side to side through the tip of the tongue, by means of which it is drawn well forward. The coagulation needle is then brought in contact with the anterior surface of the tongue as far back as is necessary, even to the epiglottis, and the current is turned on, either by the operator by means

of a foot control, or by an assistant on signal. The needle is then moved across the tongue and carefully inserted into it at different points, coagulation being allowed to take place as it moves. After this has been thoroughly accomplished, the tip of the tongue is elevated by means of the suture, and a straight, sharp sewing needle of proper length is substituted for the curved knitting needle previously used. The frenum is then coagulated, and the needle inserted between the tongue and the floor of the mouth. When coagulation is again completed, curved scissors may be used to cut through the coagulated areas on both surfaces, and the tongue then separated from its attachments. The after-treatment consists of the use of a simple antiseptic mouth wash and the application, two or three times daily, of a weak solution of sodium hypochlorite, which sterilizes, deodorizes and tends to keep the slough firm and free from maceration. Care should be taken not to remove the slough prematurely, else secondary hemorrhage may occur. Usually, organization takes place in the vessels before the time for the separation of the slough. When a preliminary ligation has been performed, hemorrhage, of course, is not so much to be feared. Such a major electrothermic operation should be performed in a well-appointed operating room, the same preparatory technic being used as in any surgical operation, although perfect sterilization is not so important as in a cutting operation.

In addition to the desiccation or coagulation of the affected tissues and the sealing of blood and lymph channels, the heat penetrates beyond the area actually destroyed and devitalizes malignant cells, without permanently impairing the healthy tissue, thus lessening the likelihood of local recurrence or metastasis and conserving the maximum amount of normal tissue. Malignant cells, especially those that are least differentiated, are more vulnerable to heat, and are devitalized at a lower degree of heat than are normal cells. The thermic sensitiveness to the action of the high frequency current has been often observed clinically and demonstrated histologically. The success obtained in the treatment of malignant disease by the desiccation and coagulation methods is explained by the fact that all the malignant tissue was, when possible, destroyed with one radical treatment. The practice of intentionally treating a malignant lesion by a series of desiccation or coagulation operations is reprehensible and must be discouraged, unless, through error in judgment, an incomplete operation is performed at first, and a second becomes necessary. It is quite as irrational to do this intentionally as to expect success by excising a cancerous growth surgically in a series of operations.

CLINCAL OBSERVATIONS

Neoplasms of the oral cavity possess, in general, the same characteristics and manifest the same behavior as tumors arising elsewhere. The relative degree of their benign or malignant nature is influenced to a considerable extent by the anatomic and functional properties of the structures involved. For a better interpretation of the nature of neoplasms in general, and those of the oral cavity in particular, one must take into account not only the clinical and histologic data but also the biologic elements concerned in the development and growth of the tumor.

Our knowledge of neoplasms is meager at best. What little knowledge we have is frequently thrown into confusion because of our failure to visualize the problem as a whole, and to link the clinical and histologic evidences with the biologic factors. From the clinical aspect, the line of demarcation between benign and malignant tumors appears well defined, and rests upon the basis of special characteristics common to both. Viewed histologically, the line

of demarcation, while still evident, becomes less distinct. To the histologist, all neoplasms represent a functionless mass of proliferated cells. From the biologic point of view, all neoplasms are malignant in that they are parasites and live at the expense of the host. Thus, the border line between benign and malignant neoplasms becomes more distinct, or less distinct, or entirely obscured, according to the particular point of view of the observer.

Clinically, we look on malignant disease as distinct and apart from all other diseases. Histologically, neoplasms possess certain things in common, resembling acute and chronic inflammatory tumors in that they represent an aggregation of proliferated cells, but differing in the type of cell composing the tumor; the polymorphonuclear in acute inflammatory tumors; the lymphocyte, or fibroblast in the subacute or chronic inflammatory tumors. Biologically interpreted, neoplasms are found to have a property possessed by other diseases, which is based upon an inherent attribute common to all living cells, namely, reaction to irritation. The manifestation of this reaction is cell proliferation and multiplication. Whether the proliferated element is a polymorphonuclear, fibroblastic, endothelial or neoplastic cell is, in great measure, determined by the type and intensity of the irritant.

The cause of neoplasms, whatever it may be, appears to be activated by a common factor, chronic irritation. In no other part of the body can one trace such close relationship between persistent irritation and development of malignant growths as in the oral cavity. The mouth and its structural contents, because of their peculiar anatomy and function, are frequently subject to minor trauma. A jagged tooth, ill-fitting denture, loose bridges, irritating material, such as tobacco, etc., act as irritants, and are apt to initiate a chronic inflammatory process. The inflammatory reaction persists because healing is prevented by several agencies present in this particular location, such as the frequent passage of food; the general motility of tongue and buccal surfaces, and the presence of bacteria whose activities are enhanced by the already devitalized area and the moisture and temperature of the mouth. A vicious circle is thus established.

To exemplify: A chronic inflammation of the tongue is induced by any of the above-mentioned irritants, resulting in a chronic glossitis. The inflammation persists not only because of the particular irritant giving rise to it, but also because of the location of the lesion in this particular structural and functional environment. A chronic glossitis is established, with the formation of fissures in the inflamed area that refuse to heal. The surface epithelium in the affected zone eventually responds to this persistent irritation in the form of proliferation and multiplication of its cells, leading to an overgrowth of the surface epithelium, manifested clinically as raised white patches (leukoplakia). With the continuation of this vicious circle, the hyperplastic epithelium sooner or later assumes greater activities and the simple overgrowth of the surface epithelium advances. Thus, leukoplakia may be looked on as the precursor of lingual carinoma.

Again, carious teeth frequently lead to multiplication of the paradental epithelium. The hyperplastic cells, like those of the surface epithelium of the

tongue, may eventually assume neoplastic activities, giving rise to an adamantinoma of the maxilla.

As stated above, the behavior of benign and malignant tumors is influenced by the anatomy and function of the structure involved. This applies particularly to the mouth. Thus, a papilloma of the tongue, buccal surface, etc., is more likely to undergo malignant changes than papilloma elsewhere. Carcinoma of the tongue, buccal surface, alveolus or floor of the mouth is, as a rule, very destructive, and metastasis is more rapid and earlier than in other locations. The tongue is supplied by a double lymphatic system, one branch draining the submucosa and the other the muscularis. These practically envelop the whole organ from base to tip and, after pursuing an irregular course, send their tributaries to the submental, submaxillary and deep and superficial cervical lymph nodes. The lower deep cervical lymph nodes are located on the jugular vein, the upper deep cervical near the common carotid just above the point of bifurcation. The rich lymphatic network therefore offers many avenues for the travel of the various cancer cells to the neighboring lymph nodes. The location of the lymph nodes and their relation to vital structures influence in a great measure the clinical course of malignant disease of the mouth.

While squamous cell carcinoma is the growth most frequently encountered, one not infrequently meets with other types in the oral cavity, such as sarcoma, adamantinoma, epulis, papilloma, hemangioma and lymphangioma. Epulis, adamantinoma and papilloma, though classed with benign tumors, may assume active growth and pursue a malignant course.

The grading of tumors according to the method of Broders gives some indication as to prognosis, and has an influence on the choice of treatment.

Since the actual etiologic factor is still unknown, no specific having yet been discovered, we must use such methods as have proved to be of value in combating this disease. They include, as stated before, surgery, the roentgen ray, radium and electrothermic methods (desiccation and coagulation). While surgery plays an important rôle, its usefulness has, in many cases, been enhanced by the employment of roentgen rays or radium as preoperative and postoperative adjuncts. In certain instances, roentgen rays and radium, either singly or in conjunction, have entirely replaced operative surgery. Like surgery, desiccation and coagulation remove the tumor growth, but, unlike surgery, they do not act as a mere physical agent removing the growth *en masse*, but destroy the neoplastic cells *in situ* to some depth below the actual tissue destroyed.

In the removal of a neoplasm, while the chief object is the destruction of the malignant cells, a secondary important factor is the maintenance and preservation of the vitality of the adjoining healthy tissue, and that is influenced, in a large measure, if not altogether, by the associated degeneration and fibrosis. The observation that the resulting scar in the case of electrodesiccation and coagulation is soft, and not so extensive as that resulting from the use of other methods, may not only be confirmed clinically but also explained histologically.

The electrothermic methods are gov-

erned by certain fundamental principles. They are dependent, for their results, on the resistance of the tissue to the current, which manifests itself in the formation of heat. The high frequency current used in desiccation is of a relatively low amperage, producing only a moderate degree of heat, but of sufficient intensity to cause complete evaporation of the fluid content of the cell. The coagulation current is, on the other hand, of comparatively high amperage and low voltage, and induces such intense heat that the cells are not only dehydrated but their protoplasm is coagulated as well.

HISTOLOGIC STUDIES

The microscopic picture of neoplastic tissue submitted to desiccation presents typical characteristics. While the cells still retain their outline, they appear shrunken, elongated and dried up, not unlike the tissue seen in mummification necrosis. Evidence of such degenerative changes as hydropic or fatty degeneration are not discernible. The blood vessels in the immediate and adjacent vicinity of the field of operation are thrombosed.

In tissues subjected to coagulation, there is complete loss of cell outline. The neoplastic cell elements seem to have fused into a structureless, homogeneous mass, a hyalinized appearance resulting. The blood vessels and lymph channels are thrombosed. The secondary and associated changes in all such lesions are regeneration and fibrosis. Whether the fibrous connective tissue shall be abundant and dense, or less abundant and soft, is influenced by the amount and nature of the accompanying degenerative and necrotic material, which, in turn, are determined by the particular type of irritant. Thus, after desiccation, the fibrosis is slight and the resulting scar is soft and pliable. Following coagulation, the fibrosis will be more or less abundant, this depending on the intensity of the heat generated and the consequent degree of frame destruction. The size of the subsequent slough or sequestrum, where bone is involved, is, therefore, largely under the control of the operator.

SUMMARY

Many years of experience have demonstrated to us that malignant disease of the oral cavity, while always a most serious affection, is not necessarily hopeless, since may brilliant results are obtained by the judicious employment of the methods mentioned, of which the electrothermic method for treatment of the local lesion holds first place. Operative surgery may frequently be employed to advantage for the ligation of blood vessels, possible secondary hemorrhage being thus prevented; or to expose a growth in the antrum, for example, so that the electrothermic method may be employed to better advantage. Radium and the roentgen ray are used in our practice principally to control metastasis to the cervical lymph nodes, and their value for this purpose has been definitely established.

DISCUSSION

H. M. Davis, Baltimore, Md.: In Louisville, last year, I deplored the tendency on the part of the medical profession to cut deeply and, it appeared to me, too quickly. I have seen cases of extreme disfigurement produced where it appeared unnecessary. Dr. Clark's work unquestionably has passed the stage of experimentation. He has shown us what can be done by treatment. In the various forms, unquestionably, he has to use a knife; he doesn't deny that, but I don't believe he uses the knife until it is definitely established that that is necessary. As I said last year, once an operation is performed, you

cannot prove that it was not necessary, and in many instances patients are needlessly disfigured for life. There are two or three questions I should like to ask. Ward reports a successful treatment of a ranula without operation other than desiccation. Someone has told me that you successfully removed tonsils by the electrothermic treatment. I should like to know whether or not, in these cases, you curet and, if you do remove tonsils successfully, whether it is ever done under local anesthesia. It has been my experience that the epulis, or so-called epulis, is usually brought about by traumatic conditions in or about the teeth, and unless that condition is of itself corrected, the removal of the epulis, it matters not by what method, is not successful, as it will usually return.

A member: The question of postoperative pain occurs to me.

A member: In regard to the treatment of bone lesion, is that allowed to form?

Dr. Clark (closing): I appreciate Dr. Davis' remarks. I can confirm Ward's reports on the successful treatment of ranula by the desiccation method. Desiccation is the treatment *par excellence* for euplis. As Dr. Davis states this condition is caused by a traumatic condition in or about the teeth, and this must be corrected before, or after, epulis is treated else there will be a possibility of recurrence. Bone can be devitalized by electrothermic methods quite as readily as can tissues. A sequestrum is permitted to form, which is removed at a later period, rather than immediately by a rongeur. Replying to the questions in regard to the treatment of infected tonsils by desiccation: The following is quoted from a recent paper by me on this subject. 1. The open operation for the complete removal of infected tonsils is satisfactory for the average case, but this operation cannot be regarded as being free from hazard, since there are instances, especially in the case of adults, when its employment is attended with considerable risk. 2. The actual cautery may be successfully employed in selected cases of localized superficial tonsillar infection, but there is a possibility of sealing up infection in the deeper tonsillar tissues, owing to the superficial action of the cautery. An undesirable fibrous cicatrix may follow cauterization of tonsils, owing to the intense heat at points of contact, sometimes resulting in impairment of the voice. 3. Radium and x-rays have been shown to be of some value in the treatment of infected tonsils, but the results are not uniform. These methods will not replace those that immediately remove or destroy the tonsils *in situ*. 4. Ultra violet rays have only a superficial bacteriacidal influence; hence, a more powerful agent must be employed to sterilize the deep tonsillar tissues. 5. Electrocoagulation is unsatisfactory for the treatment of infected tonsils. Its use is attended with an intense inflammatory reaction and painful edema. A contracted scar, possible injury to adjacent structures and serious secondary hemorrhage may also follow its employment. 6. Electrodesiccation, if properly applied, is a safe and effectual method for the treatment of infected tonsils in adults. I regard it as nearest approaching the ideal method. 7. Electrodesiccation of tonsils should be practiced only by throat specialists who have had training in the proper application of the method.[1]

1. The technic of electrothermic methods was demonstrated to the American Society of Oral Surgeons and Exodontists, Aug. 20, 1926, at a clinic by Dr. Clark in the William L. Clark Hospital, 2215 Walnut Street, Philadelphia.

ORTHODONTICS AS A PROFESSIONAL PURSUIT*

By F. M. CASTO, D.D.S., Cleveland, Ohio

IN order that one may have the proper perspective, or be introduced formally to the subject under discussion "Orthodontics as a Professional Pursuit," a brief review of the history of orthodontia leading up to its specialization seems expedient, if not altogether necessary.

Orthodontia, like all other specialties of medicine and dentistry, and all other sciences, has required a long period of time over which to develop. It has experienced the same phenomena as those which characterize the development and growth of the human organism, periods of rest and periods of activity, the remissions, of necessity being much longer in duration. Likewise, it has experienced times of depression and reversions and times of progress and advancement. Historical data seem to establish the fact that orthodontics, or rather the attempt to straighten irregular teeth, has been practiced for many centuries. Dr. Weinberger, in his recently published works on the history of orthodontia, calls attention to the writings of Hippocrates, who, in the sixth book of Epidemics, wrote "Among those individuals whose heads are long shaped, some have thick necks, strong members and bones; others have strongly arched palates, their teeth are disposed irregularly, crowding one on the other and they are molested by headaches and otorrhea."

Thus, it seems that, about 400 B. C., malocclusions of the teeth were recognized, and being recognized as a physical defect or abnormality, is it not, even in the absence of definite data, reasonable to suppose that an attempt was made at correcting them. Further, Dr. Weinberger calls attention to the beginning of specialization in medicine through the historical writings of Herodotus, who visited Egypt about the year 450 B. C., and who wrote "There is an individual healer for each individual ailment, hence the whole country is filled with healers, some taking charge of the diseases of the head, others of those of the eye, others of those of the teeth. Thus we find medicine divided among them, each physician applying himself to one disease only and not more."

Since the beginning of time and in all ages, the actions of various peoples have been governed, largely at least, by precedent, tradition, custom, habit. Therefore, with such a background as this, the orthodontist may, if for no other reason, feel justified in devoting himself to a special field of practice.

We may now pass rapidly along, bridging the historical gap up to 1530 A. D., and pausing only long enough to state that wherever civilization

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reigned, the advanced scholars and investigators of the times were always cognizant of the fact that the mouth and teeth were important factors in the life of the individual and were constantly endeavoring to solve the problems presented in those times.

The period between 1530 and 1728 has been beautifully developed by Dr. Weinberger through the accumulation of historical data. Though the advancement in dental science was slow and tedious, it was constant. The necessity for the treatment of mouth lesions was well recognized, although the methods employed were crude and unscientific.

The advent of Pierre Fauchard into the profession, about 1730, seems to have marked the most important epoch, and may be said to have marked the beginning of organized dentistry. It is he who has been called the father of dentistry. His writings covered a broad field, in which he incorporated a considerable discussion on methods for the correction of malposed teeth. Some of the principles promulgated by him are still basic. After Fauchard's time, for a century the base of operations, as far as the advancement and progress of dentistry was concerned, shifted to England and America, where it has remained, with few exceptions, ever since.

The century from 1825 to 1925 has marked, as might be expected, the greatest progressive evolution in scientific dentistry and orthodontia. It would seem inadvisable and quite unnecessary at this time to discuss the status of orthodontia for the period between 1825 and 1890. The year 1890 marked the beginning of what some are pleased to call modern orthodontia. I shall pause to pay tribute to those noble, stout-hearted, fearless, courageous and industrious men who, through their indominable spirit, persistence and application, made to orthodontia contributions of inestimable value. Their achievements, in the face of seemingly insurmountable difficulties, formed the foundation upon which modern orthodontics has been built.

It may be said without reservation that the science of orthodontia has made its greatest and most rapid strides since about 1890. This may be variously accounted for, the principal reason being the development of specialization. There were, I believe, by the year 1900, a half dozen men devoting their entire time to the practice of orthodontics, the confines of which were America. At present, there are about 500 orthodontic specialists, and they are scattered almost over the entire universe. This new era was brought about by the classification of knowledge and the establishment of schools. At this point, I should be derelict in my duty if I did not state, as I have many times, that, in my belief, Dr. Edward H. Angle has contributed more to the establishment and maintenance of modern orthodontics than any other person living or dead. I say this without prejudice, without attempting to take away one iota of credit from men possessing such sterling qualities, such high ideals, such devotion to orthodontia as Kingsley, Farrar, Talbot, Baker, Goddard, Guilford, Case, Jackson and others.

Dr. Angle correlated the various so-called methods of practice; he condensed and eliminated; and he seemed possessed of an uncanny ability to make practical application by selection of those things best adapted to practice.

He organized and classified orthodontic knowledge then extant, adding to this his own knowledge and experience. He coordinated the theoretical and practical, developed and improved technic and made a thorough investigation and study of collateral subjects. He then organized a school of orthodontia and accepted the first class in 1900. The organization of this school did more than any other thing to establish orthodontia as a specialty. Without this course of instruction, men would have had but little, if any, opportunity to prepare themselves for the special practice of orthodontics. His ideals were high; aims, lofty, and standards, par-excellent. His vision and forethought have been amply proved by subsequent results. Out of this beginning, and in accordance with the natural trend of things, other schools of orthodontia developed. Some could not withstand the high pressure of the requirements demanded, and so perished. Others survived, and so along these avenues many persons have passed through the portals to engage in the special practice of orthodontics.

Here, a discussion of the relation of the specialist to general practice and to the general practitioner seems appropriate, and possibly necessary. It may be stated by common consent that, within the past half century, several of the learned professions have experienced an accretion of knowledge that has tremendously broadened the horizon of each. This is true not only in dentistry and orthodontia but also in medicine, law, engineering, teaching and more recently segregated professions. As a result of this increase of knowledge, the condition existing fifty years ago, when a man could, with reasonable efficiency, encompass his entire profession, is no longer possible. The professional man today must either choose to be superficial or general in all phases of his profession or he must give his attention to a restricted field, at the expense of greater superficiality in or almost total neglect of the scientific study of the other parts. The difficulty arises from drawing a line between the group who are justly entitled to be called specialists and the usually more extensive group who may be designated specialists by courtesy only and whose only simulation of the genuine is in their announcement of an intention to engage in a special field of practice.

The man who chooses a special field in any profession is obliged not only to restrict himself but also to excel in that field. This excellence can come in only one of two ways. The first is through specific courses of instruction under real masters in the field selected. Such instruction must be extensive as to time, and, during this time, the individual must devote himself to study with far more assiduity than is required of the ordinary undergraduate student. But even this is not enough: Courses and hard study will not make a genuine specialist. The individual must, first of all, have talent. To this must be added opportunity, and to these two, devotion, industry, a desire to achieve and a certain degree of maturity; all based upon breadth of education and experience. As a corollary to the foregoing, it is quite evident that the course of a few weeks cannot make a specialist, nor can the experience of travel to a distant or foreign city in which a sort of vacation is passed with entertainment and diversion as major factors. Lapse of time and constant hard study are

lacking in both these methods, and they are essential. Those who have such experiences are only specialists by courtesy.

The second method of becoming a specialist is by restriction of practice more and more, and by improvement in the field through repetition. This usually results in the development of a specialist in the art of practice, and not in excellence in the science of the field. In this method, there must elapse a long period when the individual is neither general practitioner nor specialist. Although it is not usually appreciated, this method requires a longer time, harder study and more talent than the first method outlined. It may result in specialists by courtesy, with no special excellence in the science of the field, but with some improvement in the art arrived at by the empiric method of trial and error.

It is rather illogical to expect to become a specialist without first becoming adept in general practice. Without the background of a broad knowledge of the whole field of the profession, one is unlikely to maintain a correct balance of relation of his specialty to the field.

When one has arrived at a point where not he himself nor his friends but distinterested individuals of good judgment are justified in calling him a specialist, then the real battle begins. He is morally obligated to maintain a higher degree of excellence than is the general practitioner. He must study constantly not only in his specialty but also in general and related fields in order to maintain a condition of mind to appreciate the constantly changing relations of his field to the general field and to other special fields.

The specialist is a court of last resort; hence, his moral and professional responsibilities become much augmented. The general practitioner may plead ignorance and may make mistakes, for he has the higher court of the specialty to which he may appeal; but the specialist has no one to whom he can shift responsibility or with whom he can even share it, hence, he must have a high degree of talent, the best of training, and industry.

The specialist must depend on his capability for success. At the outset, he may rely on the reputation of his training or the good offices of his friends, but he must soon rely on his performances to secure him a clientele. Only the inferior and incapable specialist by courtesy will depend on his friends, or on a division of fees, to secure patients.

The man who calls himself a specialist is morally bound to refrain from professional practice outside his designated field except in emergency. He depends largely on the general practitioner and on specialists in other fields for his reputation and success. There is, therefore, a tacit gentleman's agreement that he will restrict himself to his announced field and send patients who need service outside his field to general practitioners or to other specialists. Only by such procedure can the general comity of the dental profession within itself and with other professions be maintained. It is my belief, after making an observation over a considerable number of years, that orthodontists, in general, have recognized this responsibility and have carried it out in practice.

In the practice of orthodontics, one of necessity must assume many and varied responsibilities, to the patient, to the profession, to the general practitioner and to the specialty. The ortho-

dontist, if one is to consider the broadest interpretation of the term, should not confine himself, in the practical application of his work, to any one so-called method of procedure. The reasons are obvious. It is indisputably agreed that every person possesses a certain individuality, which some one was pleased to term "an individual normal." It is also agreed that the same orthodontic procedure is not indicated in every type of case. The orthodontist who dogmatically follows such practice may be, and often is, subjected to the severest criticisms, and rightfully so, because he has failed to meet his obligations in any sense. Such practice is irrational, unwise, stupid, and does not augur well for the progress of orthodontia. And then, in the final analysis, it is the patient who suffers most. The orthodontist should be in possession of the latest orthodontic knowledge. He should be conversant with and have a practical knowledge of the collateral sciences. In the diagnosis and care of every patient coming under his supervision, he should render a justifiable and honest service, subjecting the patient to no unnecessary treatment. He should scrupulously evade orthodontic interference for a fee. During the period of treatment, the orthodontist should keep the mouth and teeth clean and healthy. He should observe the physical condition of the teeth carefully and, if any defects are noticed, should at once refer the patient to the general practitioner, who depends on the orthodontist for such service. The parent or guardian of a patient often feels that the attendance on one specialty precludes the necessity and relieves them of the responsibility of consulting other specialists. Therefore, the orthodontist is obliged to observe any abnormal conditions and recommend the proper person to them for advice.

The general practitioner, too, has responsibilities. It is usually to him that the patient first reports, and he should be sufficiently informed to recognize malocclusions. If he finds himself inadequately equipped to make a diagnosis, he should place the child under the care of a competent orthodontist, at an early age, for care and observation; otherwise, he is open to the same censure as the general practitioner of medicine, who fails to recognize the necessity for surgical procedure. It is quite essential that cases of malocclusion be recognized early, when orthodontic interference is indicated, if the best results are to be obtained. Unnecessary delay may prove serious, and ultimate failure in treatment result. The consequences are that the patient suffers, and the orthodontist is likely to be discredited.

The general practitioner and the orthodontist should cooperate to the fullest extent, as it is only by so doing that a realization of the responsibilities of each can be fully appreciated.

CONCLUSION

I feel impelled to quote in full an editorial that appeared in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION. This editorial[1] was intended to portray the status of the practice of orthodontics as it prevails or should prevail in the minds of the members of the profession at large. It was written by a general practitioner of long and varied experience. The quotation follows:

1. Orthodontia, editorial, J.A.D.A., 13: 125 (Jan.) 1926.

ORTHODONTIA

The science of orthodontia came into the dental profession as a distinct benefaction. Groping at first in the mists and shadows of experimental uncertainty, it has emerged into the clearer atmosphere of a brighter dawn, where its achievements are penetrating the clouds and shedding sunshine over the hearts and minds of men. Sponsored by a small band of noble and devoted enthusiasts in the beginning, it has swept across the horizon of our professional activities till it embraces today the best energy of very many earnest practitioners, with an ever-increasing interest on the part of the profession and the public at large.

All honor to the pioneers in this beneficent art—the men who blazed the way—who went ahead and made a path through the dense wilderness of ignorance—long before there was system or cohesion in the movement—long before there were schools teaching the art, or societies everywhere discussing the latest and best in this wondrous specialty. It would sometimes seem as if the keenest and most progressive minds in the profession had rallied to the banner of orthodontia, and were devoting their very lives to its development.

And what a blessing it has all been. Think of the countless lives it has sweetened by its beneficence. It has freed humanity from one of its most glaring deformities, and has transformed the hideous imperfections of Nature into the essence of symmetry and beauty. It has waved the magic wand of its subtle art across the distorted features of little children, and lo, they have come forth perfect in the image of divinity. It has relieved the aching hearts of mothers, and added to the joy and pride of doting fathers. It has removed from budding youth the blight of prejudice, and destroyed the handicap which threatened to mar a human life.

It has added to health, to beauty, to opportunity, to advancement. It has snatched from many a sensitive child the horror of derision, and planted in his heart the seeds of hope and confidence and courage. It has given children a fair chance where Nature had threatened to trample them under the ruthless feet of deformity. It has sweetened the lives of countless youths, and made possible careers of achievement and success. It has turned despair into hope, and discouragement into the very joy of life.

It has, by its marvelous artistry, molded the human countenance into lines as fair as those of Apollo, and has changed the features of a freak into the profile of a god. It has wrought modern miracles great as those recorded in the script of ancient days, and made the impossible of yesterday the routine and commonplace of today. It has spread the blessings of beauty and harmony over the blighted lives of myriads now on earth, and will do the same for myriads yet unborn.

Out of the chaos of the past—the doubt, the dread, and the despair of disfigurement—has come this beneficent science, to bring solace to the sons of men. And the end is not yet. There are greater achievements ahead, and the future holds high the banner of promise and of pledge.

In the glowing east, we see the many-tinted bow beckoning in the dawning of a better day, when "all the children of all the people" shall be brought under the blessings of this benevolent art, and the cry of despair coming from the hearts of little children shall be banished from the ears of men.

When the possibilities and signficance of orthodontia are fully recognized by the world, there shall be recorded for dentistry one of the greatest achievements and greatest tributes that have ever fallen to the fortunate lot of any calling.

ODONTOCLASIA*

By F. V. SIMONTON, D.D.S., and MARTHA R. JONES, Ph.D.,
San Francisco, California

A VARIETY of dental lesions have been observed during the course of a study on inorganic salt metabolism by one of us (M.R.J.) in dogs on experimental diets. One type of lesion simulates human caries but differs from it both clinically and microscopically in certain respects. It was thought at first to be a form of tooth destruction peculiar to the dog, but similar findings in the teeth of children has given it greater significance. It seems appropriate to designate this condition "odontoclasia."

MACROSCOPIC OBSERVATIONS

The coronal portion of a characteristically affected tooth exhibits the following (Fig. 1): (1) stained areas; (2) loss of tooth substance; (3) zonation.

Stained Areas.—The stained areas may appear as spots or as broad masses, sometimes affecting the incisal tips of the teeth, sometimes distributed in broad bands occupying a zone intermediate between the tips and the gingival thirds of the teeth, and occasionally encircling the crowns. In some teeth, the gingival third of the crown will be involved, and, in others, an entire surface, axial or occlusal.

The stain varies in color. It may be white, cream, gray, yellow, green, brown or black.

Loss of Tooth Substance.—A disintegration of the tooth substance occurs coextensive with the areas of stain. In some cases, the affected tissue is soft; in others, it is dry and chalky. The lighter colored stains seem to be associated with the more active processes.

When the darker and drier (chalky) areas were first observed, the possibility was entertained that they might be merely scalelike calcular deposits. This possibility was ruled out, when it was found that the substance could be scraped away, in some cases, entirely through the enamel and well into the dentin. In certain instances, after the removal of the surface to a slight depth, hard, intact, vitreous enamel was found. In others, the crowns would be so softened that one might chisel them away, leaving merely stumps of dentin, or even cut them away entirely.

Zonation.—During the early observation of these conditions, a zonation was frequently noted, as follows: (1) an apparently intact incisal tip; (2) a wide intermediate zone, stained and distinte-

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*From the California Stomatological Research Group, the Department of Pediatrics (aided by a grant from the W. H. Crocker Fund for Research in Pediatrics), and the George Williams Hooper Foundation for Medical Research, University of California.

grated; (3) a gingival zone which was bluish.

Further study showed that the staining and disintegration were not confined to the intermediate zone but might affect either the incisal tip or the gingival. They did, however, show a tendency to be disposed in strips or rings at right angles to the long axes of the teeth.

The bluish zone proved something of a puzzle until microscopic sections were prepared, when it became apparent that this color was due to the translucency of a rather thin shell of tooth

Fig. 1.—Odontoclasia in canine tooth of the dog. A characteristically affected tooth showing zonation. Note (1) intact tip; (2) stained and decalcified intermediate area, and (3) unaffected gingival zone. This type of the lesion is common, but variations in its distribution occur.

substance and a large, highly vascular pulp. In some cases, this was a condition normal to the growing tooth; in others, there was a hypoplasia or arrest of development. It is of interest in this connection to note that the crowns of the deciduous canines are normally quite blue, and their walls thin and pulps large.

A hypoplasia, either gross or microscopic, has been found commonly associated with the odontoclasia. It was at first thought to be an essential phase of a combined developmental and retrogressive condition, but further study has thrown doubt on this point, and it is possible that the two conditions have no necessary relationship.

THE HYPOPLASIA

Since hypoplasia, both gross and microscopic, was found associated so commonly with odontoclasia, it seems desirable to discuss it briefly.

Macroscopic Hypoplasia.—This condition was observed in a number of the specimens. Figure 2 shows a common deformity. The constriction of the tip will be noted at *a*. Microscopic examination of this tooth showed that no

Fig. 2.—Gross hypoplasia in lower second premolar of a dog. Note constricted tip (a) and shoulder (b) of protoconid.

enamel whatsoever had been laid down at the tip and that the enamel subsequently formed rounded over to the dentin, producing a shoulder as shown at *b*. It should be appreciated that, owing to the simpler forms of teeth in dogs, we would not expect to find the variety of deformities that occur in man. Again, in teeth of simple conical form such as the canines, or in the incisors and first premolars, it would be possible for omission of certain of the enamel strata to occur without producing any noticeable surface irregularity or dwarfing.

Figure 3 shows a specimen in which

the teeth were quite intact, with no evidence of either gross or microscopic hypoplasia.

Fig. 3.—Upper jaw of dog, normal.

Examination of the canine (*A*) revealed[1] a tip of hard, white, lustrous enamel, and a broad intermediate zone in which the surface appeared somewhat mottled or streaked with white or blue (producing an effect somewhat like that of curdled milk). The white is distributed through a bluish field, sometimes in spots or blobs, and sometimes as streaks. The lingual surface is generally more uniformly white than the labial.

The gingival zone is bluish and translucent. The reason for this has already been stated.

A photograph of a longitudinal section of this tooth is shown in Figure 4. (It is not possible to preserve the apex in central longitudinal sections of some of these teeth because of lateral curvature.) The large pulp is not abnormal, as this was a young animal. The enamel at *a* is shown magnified in Figure 5. Aggregations of rods will be seen to be interwoven, running in various directions. No incremental lines of Retzius are apparent. In the dentin, two types of tubules (Fig. 4) appear, one in which the lumen is narrow and the parietes are thin and transparent, and in the other with wider lumen and parietes thick and opaque. The coarser tubules are variously distributed. In this specimen, they are massed in the incisal half of the crown,

Fig. 4.—A longitudinal section of canine tooth (A) of jaw shown in Figure 3. Specimen prepared by grinding with pulp in situ.

1. These markings are not apparent in the photograph.

extending from, at or near the dento-enamel junction toward the pulp to different degrees.[2] They are also scattered here and there in small groups or singly. Some of the tubules are short.

Fig. 5.—Area of enamel at (a) Figure 4, shown under oil immersion.

Others reach from the dento-enamel junction to the pulp. Some terminate in pointed extremities and merge into finer tubules or are lost in the matrix of the dentin; others appear to end abruptly as a result of passing out of the plane of the section. They are quite wavy and many of them appear segmented. These segments are much shorter than the waves and are probably due to fracture of the tubules in grinding. The possible significance of these coarser tubules will be discussed later.

Figure 6 shows the vascular supply of a section of the pulp under high magnification. Branching by dichotomy is common, and fine capillaries extend

2. They appear black in the figure but are white in the actual specimen.

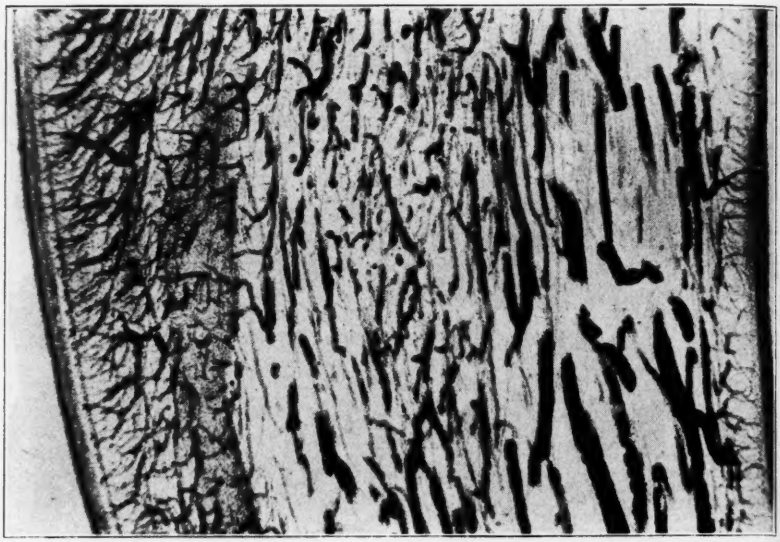

Fig. 6.—A section of the pulp of tooth shown in Figure 4; highly magnified. Note dichotomies of blood vessels and fine capillaries extending through *membrana eboris* to dentin.

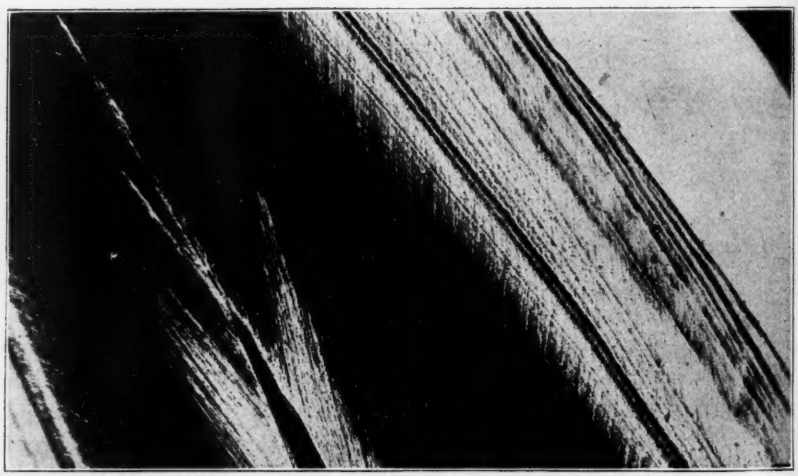

Fig. 7.—Section from lower right first incisor of a wether. Note masses of coarse tubules and clearly defined incremental lines of enamel.

quite through the *membrana eboris* to the dentin.

Figure 7 presents an interesting speci-

Fig. 8.—Specimen apparently normal but presenting microscopic odontoclasia and hypoplasia.

men prepared from the lower right first incisor of a wether. The lines of Retzius are notably distinct. The enamel rods are straighter and finer than in the dog. The coarser tubules form an opaque mass of marked extent. The lingual enamel at *a* is only about one-seventh as thick as that of the labial, at *b*. In the region of the amelocemental junction and in the root are numbers of coarse, wisplike elements resembling nothing so much as the silk threads in a greenback. They are expanded portions of tubules.

A similar section prepared from the corresponding tooth of a ram differed in the following characters: The enamel, although presenting diffuse areas of pigmentation, showed no definite incremental lines; and the coarser tubules were restricted to a limited area in the vicinity of the incisal edge.

Microscopic Hypoplasia.—Figure 8 shows a specimen hardly distinguishable on macroscopic examination from that presented in Figure 3, but in which the structure of the teeth is quite different. A photograph of a microscopic section of the upper canine is shown in Figure 9. It will be observed that, although the incisal half of the crown is fairly well developed, the parietes are much thinner than those of Figure 4—the tooth is more shelllike. Failure of development of enamel in this specimen may be seen in Figure 10. The enamel at *E* rounds down to the failing strata at *E*.[1] There has doubtless been an omission of several laminae. The formation of dentin has been aborted, leaving the tooth shelllike. The odontoblasts appear still to be well preserved. The dentin that has been formed is surprisingly free from interglobular spaces, except in certain regions near the parietes of the pulp chamber. The coarser tubules are sparse, occurring principally in the incisal half of the crown.

Figure 11 shows a case in which there was microscopic hypoplasia of both enamel and dentin. This specimen, region *b* of Figure 13, shows evidence of odontoclasia microscopically which was not observed in the macroscopic examination. This condition will be discussed later.

Figure 12 is another specimen. The dentin has been poorly calcified, as will be noted from the series of lines of interglobular spaces. The enamel showed faults similar to those discussed above. Odontoclasia was also present.

The same specimen is shown in Figure 13 at the stage in its preparation when it was ground half way through. It will be observed that the failure of development was progressive. The interglobular spaces were most marked in the inner portion of the dentin. Complete cessation of calcification oc-

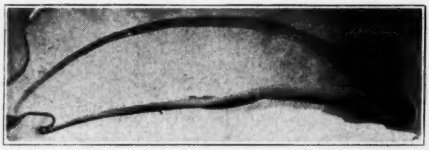

Fig. 9.—Section of canine tooth from jaw shown in Figure 8; tooth normal to macroscopic examination but presenting microscopic hypoplasia of enamel. The development of dentin has been aborted, leaving a shelllike tooth.

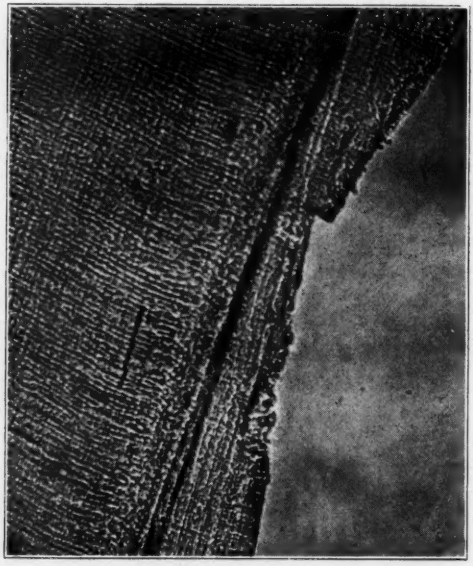

Fig. 10.—Microscopic hypoplasia of enamel. Region (a) of Figure 9.

curred along the line *a-a-a*. The pulp continued to form matrix for a time, and then ceased to function along the outline from whence it may be seen standing up in relief. The shelllike character of the crown will be noted. This condition would render it quite translucent at the gingival, as, in fact, it was.

matrix. It is to be noted that the uncalcified areas seem to be devoid of tubules. This is true of some of them, but in others tubules may be discovered by critical focusing. Wisplike tubules, such as described for the wether and ram, may be seen in some of the globules.

Macroscopic Odontoclasia in the

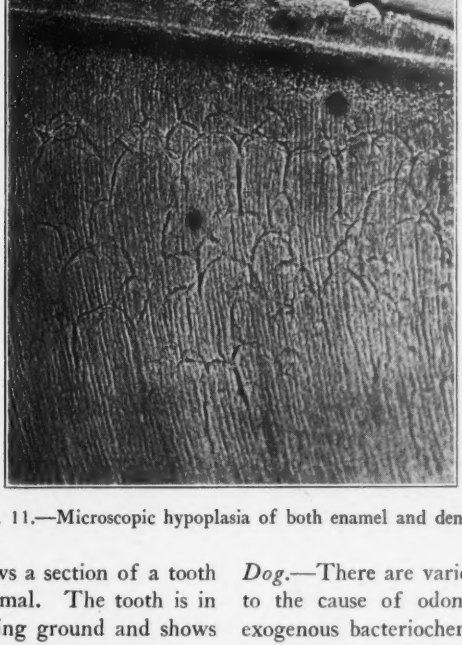

Fig. 11.—Microscopic hypoplasia of both enamel and dentin.

Figure 14 shows a section of a tooth from another animal. The tooth is in the process of being ground and shows to good advantage the distribution of the coarser tubules (white masses).

An area from the apical half of the root of another case in which the calcification was profoundly defective is shown in Figure 15. The mineral substance was markedly inadequate in amount, and numerous spherical masses have concreted in a sea of organic

Dog.—There are various possibilities as to the cause of odontoclasia. 1. An exogenous bacteriochemical factor may be responsible. 2. The process may act from within the tooth. 3. The teeth may be affected before eruption from conditions within the tissues of the jaw. 4. The hypoplasia may be primarily responsible by lowering the resistance of the teeth.

Of these possibilities, the evidence favors the first and is opposed to the

second and third. The fourth is still *sub judice*.

Is the Hypoplasia a Factor in Odontoclasia?—We were at first inclined to believe that these two conditions were

Fig 12.—Poorly calcified dentin. Note series of lines of interglobular spaces.

related, as we found them so commonly associated. If this were the case, it would then follow either that the conclusions of Black and Williams to the effect that hypoplasia does not predispose to disintegration (bacteriochemical) of the teeth were probably wrong, or that there are two types of hypoplasia. It would also be possible that hypoplasia does not predispose to caries, but does predispose to odontoclasia.

Fig. 13.—Specimen in course of grinding. Note cessation of calcification along line a-a-a and mass of uncalcified matrix between the dentin and the pulp, the latter standing out in relief.

The evidence favors the assumption that hypoplasia does not, as such, predispose to caries in the human being. Indeed, it would appear that the condition, or the factors underlying it, might even bestow some degree of immunity, for it is certain that the opportunity for local exciting factors are much enhanced. (Fig. 16.) The patient was 35 years of age. The teeth shown were quite free from caries, although in-

Fig. 14.—Specimen in course of being ground. Note distribution of coarse tubules—white masses.

volved with marked hypoplasia. Parodontoclasia (sulcicalcic)[3] is also present.

Fig. 15.—Specimen from tooth of dog showing marked failure in calcification of the dentin of the root.

Further study will be necessary before the question as to whether hypoplasia predisposes to odontoclasia can be settled. On the basis of sections prepared to date, it can be said that those teeth in which odontoclasia was most extensive showed marked microscopic hypoplasia. Some teeth in which the surfaces were, on clinical examination, apparently intact showed hypoplasia microscopically; while others, clinically normal, were found to be microscopically normal as well. But several specimens which were of normal development microscopically showed suggestions of odontoclasia.

Fig. 16.—Gross hypoplasia in human case (patient aged 35 years).

3. Simonton, F. V.: Pyorrhea: Definition and Classification, Dent. Cosmos, 68: 158-162 (Feb.) 1926.

It may further be stated that gross and microscopic hypoplasia are not necessarily concomitant; also, that microscopic hypoplasia of enamel and dentin may occur variously, i.e., one without the other.

Fig. 17.—Gross hypoplasia and odontoclasia.

Fig. 18.—Odontoclasia. Note disintegration in intermediate zones of canine and incisors.

It must be admitted that the question is *sub judice;* for there is a school of thought which does regard hypoplasia as predisposing to human dental caries. Furthermore, it should be appreciated that the character of the enamel and not that of the dentin is the important factor in the initiation of either dental caries or odontoclasia. Microscopic hypoplasia of enamel is rather less easily recognized than that of dentin; for the

omission of a few increments of the former may produce no apparent deformity, while faults in the latter are evidenced by areas of uncalcified matrix or by aberrant pulp structure. Again,

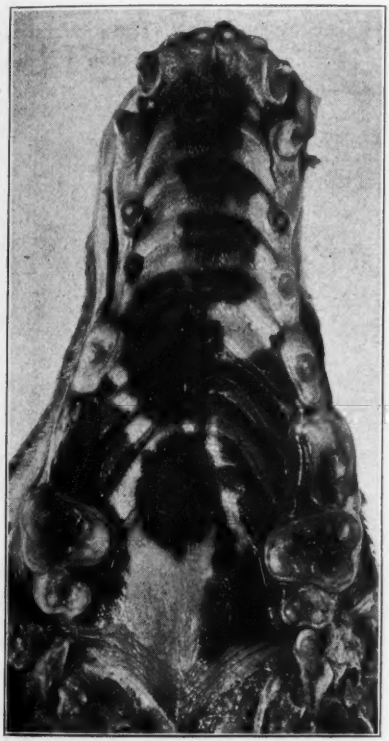

Fig. 19.—Odontoclasia. Note areas of stain on occlusal surfaces of first molars. These regions were chalky and could be scraped away.

there may exist faults in the development of enamel which present technical methods do not reveal.

To summarize:

1. Hypoplasia, both macroscopic and microscopic, is associated with rickets-like conditions which occur spontaneously in young dogs, or have been induced by a diet containing an excess of basic ions.

2. The teeth of certain of the experimental animals studied exhibit the lesion of odontoclasia.

3. Hypoplasia has been found in many of the teeth affected by odontoclasia which have been studied, but it

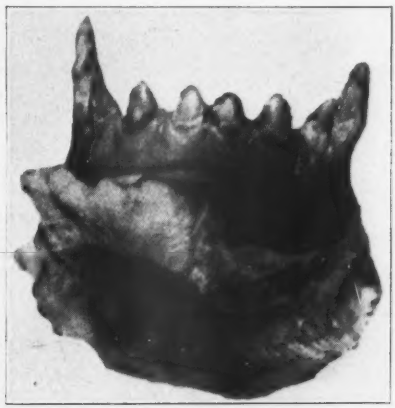

Fig. 20.—Odontoclasia. These incisors were shaved away with a chisel well into the dentin.

has also been found in teeth not affected by this condition.

4. Therefore, although hypoplasia, especially microscopic hypoplasia of enamel, may predispose to odontoclasia, the cause of the two conditions is probably not the same.

Are the Odontoclastic Teeth Affected Before Eruption?—None of the unerupted teeth which have yet been removed from the preserved specimens have shown any signs of odontoclasia. The crowns of the developing teeth

are encapsulated in their follicles until shortly before eruption. It seems doubtful that, if any agency were acting on the tooth substance with sufficient intensity to effect its disintegration, the injury would be confined to any given localities. It seems, rather, that the entire crown would be ravaged.

The lesion does not represent a developmental fault, but a progressive disintegration. Cases under observation have shown a continued destruction, which would rule out a preeruptive etiology.

Does the Destructive Process Affect the Tooth from Within?—This question can be answered definitely in the negative; for study of the various stages of progress of the lesion makes it clear that the disintegration progresses from without inward. In some cases, the surface only of the enamel is affected; in others, the enamel has become thinner; in still others, the entire enamel is penetrated and the dentin is involved to varying depths.

The clinical findings point to an exogenous bacteriochemical complex as the causative agency. The localization of the lesions is a function of two opposing general factors: (1) areas of stagnation, and (2) the cleansing of teeth through function. These factors may be illustrated from Case 87. The clinical examination showed the following:

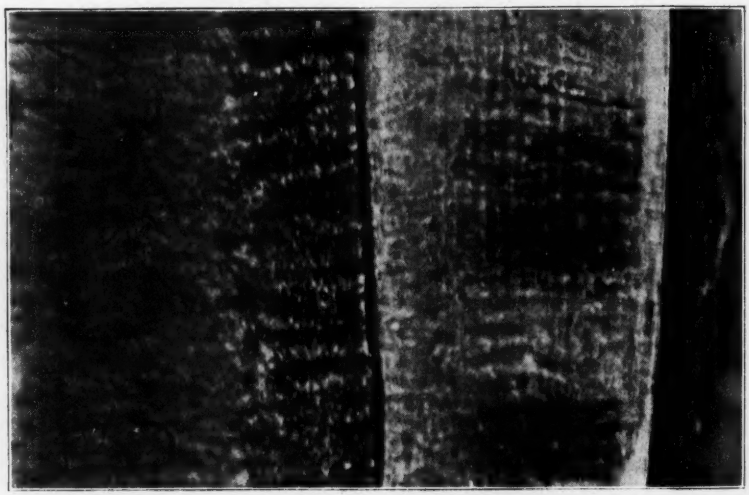

Fig. 21.—Early stage of odontoclasia.

Upper right first incisor: Labial surface stained a light yellow, brownish near the gingival; gingival very slightly chalky.

Upper right second incisor: Labial surface stained a light yellow, brownish near the gingival; gingival slightly chalky.

Upper right third incisor: Labial surface stained yellowish, brownish near gingival; mesial half of gingival slightly chalky.

Upper right canine: Good.

Upper right first premolar: Good.

Upper right second premolar: The tip of protocone was hypoplastic and discolored and chalky.

Upper right third premolar: Tip of protocone hypoplastic, brownish and chalky.

Upper right fourth premolar: Tip of protocone good. The central area of the mesial slope of the protocone was affected by staining and disintegration, which spread to the buccal and lingual surfaces.

Upper right first molar: Buccal and occlusal surfaces affected.

Upper right second molar: Paracone affected.

Lower right first incisor: Slight staining and softening of labial at gingival.

Lower right second incisor: Very slight staining and softening at gingival of labial.

Lower right third incisor: Good.

Lower right canine: Very slight stain and suggestion of chalkiness on labial surface (opposite canine was not affected).

Lower right first premolar: Good.

Lower right second premolar: Intermediate zone odontoclastic.

Lower right third and fourth premolars: Had been excised. The whole crowns of the left third and fourth premolars were affected, especially on the buccal surfaces.

Lower right first molar: The intermediate and gingival zones of the buccal surface and the gingival zone of the lingual surface of the trigonid were affected, also the buccal, lingual and occlusal surfaces of the talonid.

Fig. 22.—Odontoclasia, more advanced than that of Figure 21.

Lower right second molar: Protoconid, metaconid and occlusal surfaces stained. Distal margin of occlusal surface intact.

Lower right third molar: Good.

The upper and lower first and second incisors erupt at about the same time, and they were all affected. The third incisors erupt later. Of these, the lowers were good and the uppers less affected than the first and second incisors. The canines also erupt later. These were good. The first premolars were good. They erupt early, but are

so shaped as to give little opportunity for lodgment of food débris. The other premolars were involved. The first molars were affected, but the tip of the trigonid on the lower first molar and the lingual slope of the protocone of the upper fourth premolar (contact-

Figure 17 shows a case in which the incisors and canines, the first molars, both trigonids and talonids, and the protoconids and paraconids of the second molars were affected. Gross hypoplasia is evident on the second, third and fourth premolars. The lesion

Fig. 23.—Pulp of odontoclastic and hypoplastic tooth.

ual surfaces) were good. The entire talonids of the lower first molars, which are subjected as a whole to stagnation of débris during the eruptive period, were affected. The lower second molars, which erupt slightly later, were involved on those cusps and areas first exposed. The lower third molars which came through the gums last were good.

on the trigonid of the first molar extends in a band across the intermediate zone, and the gingival is good. The tips of both this and the corresponding trigonid on the left are good. The incisal halves of the canines are involved. In Figure 18 it will be noted that the intermediate zone of the canine is involved and the gingival of the sec-

ond and fourth premolars and first molar.

As a result of observations on a number of cases, both in the living animals and on preserved specimens, the localizations have appeared to be distributed as follows:

During the period of time (which may in some cases be relatively brief) at which the etiologic agent is active, those areas of the teeth will be affected which are most subject to stagnation.

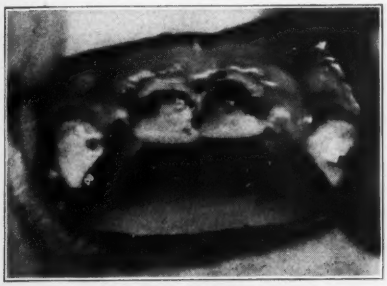

Fig. 24.—Mouth of 3-year-old child with florid rickets previous to treatment. (Case 2.)

These will be the labial surfaces of incisors, especially those zones which are adjacent to the crests of the gums at the particular time, the labial surfaces of the canines, the buccal surfaces of the second, third and fourth premolars, the buccal and occlusal surfaces of the lower first and second molars, the buccal and occlusal surfaces of the upper first molar and the paracone and protocone of the upper second molar. Because of their simple conical forms and the thin investing gum margins, providing little opportunity for stagnation, the first premolars, and the canines (in part) are apt to escape. So also are the lower third molars, and the upper second molars in part, because of their late eruption.

The surfaces of the teeth which are in actual contactual relationship tend to be preserved, although this is not always the case. The cleansing effect of the excursions of food in chewing is evidently of little value, since these animals are fed on pap which requires practically no mastication.

Fig. 25.—Knee of 3-year-old child with florid rickets previous to treatment (Case 2.)

After the paroxysm of destruction passes, portions of the teeth which at the time were protected by the free margin of the gum and which later

erupted are found to be perfect. (Figs. 19 and 20.)

The localization of odontoclasia appears to be the antithesis of that of dental caries; for, in the former, smooth, exposed surfaces are attacked, while those few regions where deep pits and fossae exist remain sound even though buried in débris. Furthermore, the odontoclasia is characterized by a loss of substance *en masse*, whereas dental caries tends to burrow.

Fig. 26.—Mouth of child, aged 3 years and 6 months, after treatment was instituted. Note increased destruction of tooth substance. (Case 2, before treatment.)

It must be appreciated, however, that we would expect a different localization of true dental caries if it were found to exist in the dog, where there is practically no opportunity for proximal caries or occlusal pit and fissure caries. The lesion in dogs resembles most the gingival third and senile caries.

Microscopic Odontoclasia in the Dog.—The most distinctive microscopic character of odontoclasia lies in the tendency of the process to advance in parallel lines, rather than in flame-like extensions as does dental caries. Figure 21 shows an early stage in odontoclasia. The condition extends along the rods of the enamel for varying distances toward the dento-enamel junction. The interprismatic cement substance is stained in hues of brown. The lesion advances in a series of columns of different widths and appears not to affect materially the integrity of the lateral margins of the rods at this stage.

Fig. 27.—Parodontoclasia in child, aged 3 years. (Case 2, after six months on acid milk, cod-liver oil and light therapy.)

In areas where bundles of the rods pursue sinuous courses, the lesion follows them with great fidelity. The cement substance appears to be dissolved away and the staining seems to be on the lateral surfaces of the rods.

The granular layer of Tomes is stained. It will be noted that the line of advance is parallel to the dento-enamel junction.

Figure 22 shows a more advanced condition, in which the enamel has been invaded *en masse*. The penetration through the dentin is again in a parallel line. Remarkably enough, the advance of the lesion does not seem to be accelerated even by the marked hypoplasia of the dentin.

The pulp of an odontoclastic and hypoplastic tooth is shown in Figure 23. It is characterized by marked vascularity, cellular hyperplasia, fibrosis and degeneration of the odontoblastic layer.

Fig. 28.—Case 2, six months after treatment was instituted. Note improvement in skeletal condition which was accompanied by an increase in destruction of tooth substance.

Macroscopic Hypoplasia in the Human Being.—Conditions have been observed in children which have conformed closely to those described in the experimental animal. Two cases in which the conditions were particularly clear cut will be described.

REPORT OF CASES

Case 1.—A girl, aged 3, was examined, June 24, 1925. All the deciduous teeth were present. The bite was open anteriorly. The anterior teeth were slightly loose. The labial surfaces of the upper central incisors were stained and covered with débris. The lateral incisors were stained. The upper left cuspid was denuded of enamel across the mesial surface and practically all of lingual surface except the distal marginal ridge. The exposed dentin was fairly solid, about one quarter of the labial surface being disintegrated. The lingual surface of the upper right cuspid was denuded of enamel, and the labial surface was pitted and chalky. The upper and lower molars presented considerable areas of denudation on the lingual and occlusal surfaces. The occlusal pits were not noticeably softened. The lower incisors were stained orange on the labial surfaces. The enamel was chalky.

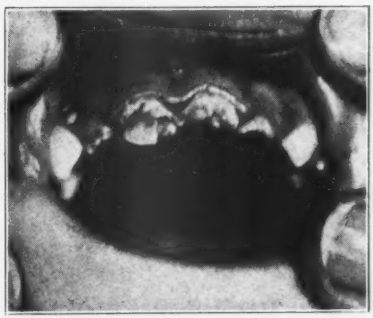

Fig. 29.—Odontoclasia in a rachitic child.

The gums were inflamed and receded detachments of several millimeters were measured on various teeth.

Case 2 (Fig. 24).—The twin sister of the patient in Case 1 was examined, June 24, 1925. The stain on the anterior teeth was very dark in places, and, in some areas, it was black. Débris was present in quantity. The more deeply stained areas were less softened than the lighter ones. The opaque white or light yellow regions were the most chalky. They could be shaved away easily with a

chisel. The molar teeth were better preserved than in Case 1. The gums were inflamed and tumefied. Recessions and detachments may be seen to the labial of the lower incisors (Fig. 26). A radiogram of the knee of this child, taken during the florid rickets, is shown in Figure 25.

Both of these girls were rachitic, Patient No. 2 markedly so (she was not able to sit alone at three years). Patient No. 1 was a runabout child. The odontoclasia was less and the parodontoclasia more marked in No. 2 than in No. 1. Hydrochloric acid milk, cod-liver oil and sunlight therapy were instituted. After this treatment, the relative dental conditions of the twins were reversed, but markedly aggravated. Figure 27 shows the same case as Figure 24, six months after therapy was instituted. A radiogram of the knee taken at the same time, is shown in Figure 28. Subsequently, as the condition improved, the odontoclasia became static.

Portions of the teeth that had become most recently exposed, owing to continued eruption of the teeth, were intact; the gums were practically free from inflammation, and the mouths were markedly cleaner. The mother had made little effort to brush their teeth, explaining that they cried whenever she attempted to do so. To rule out this factor, she was asked to refrain entirely from any effort to cleanse the teeth or mouth for a period of two weeks. After this time, examinations were again made and the mouths found to be clean and healthy. It is believed that the change from filthy to clean mouths was under the control of the systemic conditions.

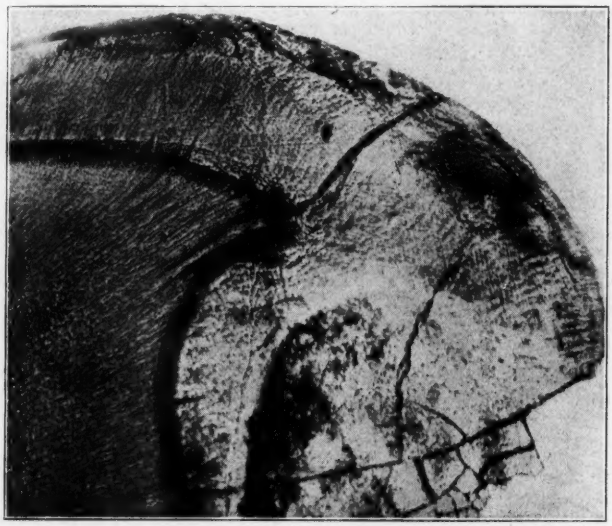

Fig. 30.—Odontoclasia in rachitic child, aged 3 years. (Case 2.)

Fig. 31.—Odontoclasia in rachitic child, aged 3 years. (Case 2.)

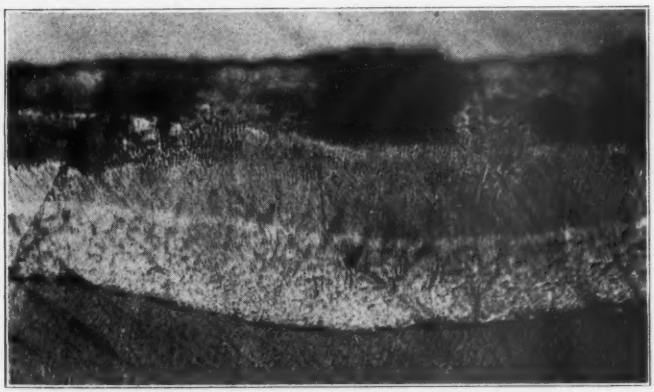

Fig. 32.—Odontoclasia in rachitic child, aged 3 years. (Case 1.) The progress of the condition through the enamel is shown.

A few lesions presenting the clinical and microscopic aspects of dental caries were observed in these mouths.

Findings similar to those described were made on a number of children ranging in age from 2 to 12 years. Figure 29 shows a characteristic condition in another patient. In many of the cases, the odontoclasia was more or less masked by dental caries.

Microscopic Odontoclasia in Man.—The upper right lateral incisors were removed from the two patients described above, and microscopic sections were prepared. Photomicographs of the tooth from Case 2 are shown in Figures 30 and 31. The enamel and dentin were hypoplastic. Numerous interglobular spaces are apparent. The series of such spaces following the recessional lines of the pulpal horns may be noted. At *a* are odontoclastic regions advancing along fronts parallel to the dento-enamel junction. As a contrast, there may be observed a carious lesion on the proximal surface at *b*. (Fig. 31.) The latter shows the charasteristic flamelike extension through

Fig. 33.—Pulp from hypoplastic and odontoclastic tooth. (Case 1.) The extreme vascularity, hyperplasia of cellular elements and fibrosis are shown. The odontoblasts (not shown) were degenerate.

the enamel and the conical form of the affected dentin.

A section of the incisal of the tooth of Case 1 is shown in Figure 32. Three laminae of enamel may be seen at e,[1] e^2 and e.[3] This stratification results from difference in direction of the rods in each of the layers. At *a*, the odontoclasia has penetrated through the outer layer, leaving the enamel disintegrated and granular. In advance of

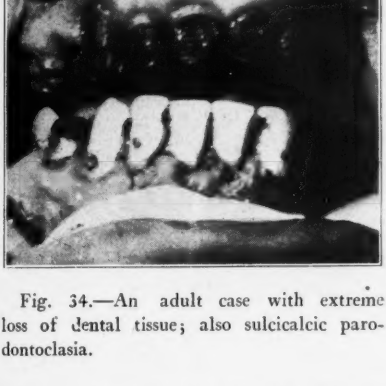

Fig. 34.—An adult case with extreme loss of dental tissue; also sulcicalcic parodontoclasia.

the granular mass, the cement substance is dissolved away from between the rods for a short distance, *b*. At *c*, the process may been seen advancing through the second stratum. The loss of cement substance precedes the stain to a slight extent. At *d*, the lesion is still further advanced.

A small area of the pulp of the tooth from Case 1 is shown in Figure 33 under high magnification. It evidences the same characters as observed in the pulp of the dog's tooth (Fig. 23), namely, marked vascularity, cellular hyperplasia and fibrosis. The odontoblasts are likewise degenerate.

Report of an Adult Case.—An interesting adult case which we thought might be odontoclasia is shown in Figure 34.[4] The patient, aged 34, had typhoid fever in 1917, and again in 1919, and diphtheria for twelve weeks in 1918. He claims that his teeth were ruined by taking medicine (iron) and that he first noticed the teeth beginning to crumble away six months after having accidentally crushed between his teeth the glass tube through which he was taking his medicine. (It is impossible that one such occurrence could bring about this destruction.) During infancy, the patient was breast fed for a short time and then placed on Horlick's

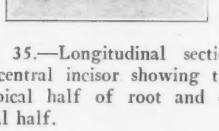

Fig. 35.—Longitudinal section of upper central incisor showing translucent apical half of root and opaque gingival half.

malted milk. He had mumps at the age of 3 years.

The blackened stumps of the teeth seemed quite firm. The upper teeth were extracted, Nov. 22, 1925. At this time, we were making observations of odontoclasia in children, and it occurred to us that this might be an adult case of the condition. Since we had found large pulp and imperfectly developed roots associated with odontoclasia, it was thought that such conditions might obtain here. Just previous to the extraction, the patient told us that his teeth had long, thick roots, which it was very difficult to remove. This we found to be true, and the teeth consequently did not conform with our surmise. A longitudinal section of an upper central

4. For description of microscopic findings on the paradontal tissues, compare Simonton, F. V.: The Etiology of Parodontoclasia, J.A.D.A., to be published.

incisor presented the interesting appearance shown in Figure 35. The gingival half of the root was quite opaque and the apical half translucent. It then occurred to us that the pulp may have ceased to function when half of the root had been completed, and that the dentin was made up in large part of the coarse type of tubule, and the apical half of fine tubuli.

The association of coarse tubules with hypoplasia and with caries and abrasion gives rise to the impression that they are indications

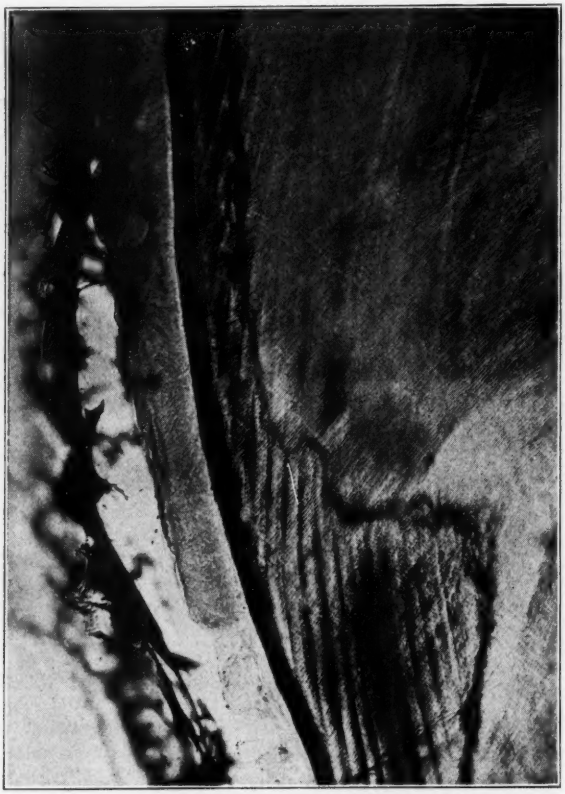

Fig. 36.—Enamel of tooth from case of extreme tooth destruction in adult.

balance of the latter had been formed of cementum, assuming that the translucent apical half *was* cementum. But when the microscopic section was prepared from this specimen, we found, on the contrary, that the cementum was quite normal in position and thickness and that the apical half was merely translucent dentin. The difference lay in the fact that the gingival half of the

of developmental or pathologic abnormalities or both. The teeth are unique among the tissues of the body, in that parts, after formation, are physiologically unalterable.[5]

5. They are altered, of course, by disease, such as caries or scurvy, (compare Höjer, A., and Westin, G.: Dent. Cosmos, 67: 1 (Jan.) 1925) or by attrition.

Consequently, they preserve a record of the physiologic events which have transpired in the life of the individual during the time they were being formed, as far as teeth may be affected by the somatic conditions. It is believed that the appearance of the coarser

Fig. 37.—Odontoclastic lesions on anterior tooth of dog, resembling gingival third and senile caries.

tubules may be indicative of minor events. It is remarkable how closely the teeth, from this standpoint, parallel the history of geologic episodes and zoologic developments, as preserved in the rocks. The tooth actually constitutes a fossil record. For this reason, it is of more significance to the experimental biologist than has heretofore been recognized.

A section of the enamel from the distal surface of the lower right second bicuspid of this case is shown in Figure 36. The strip at *b* resembles odontoclasia, but the involvement at *a* is typical of caries.

The lesions on the labial side of the lower anterior teeth (Fig. 29) resemble somewhat those shown in Figure 37, from a dog. The former are probably true caries.

Our final judgment is that this case is not one of odontoclasia, but a case in which a relatively brief period of intense caries susceptibility (possibly in connection with the typhoid fever) wrought the damage.

It would occur to one that these teeth might correspond to those described by Black in which the carious process "shells" away the coronal cap from the zone of interglobular spaces in hypoplastic teeth. This is a possible explanation, but doubtful, as the lower teeth do not show any signs of such hypoplasia, which would have left its mark at the same time as in the upper teeth.

Bacterial Findings.—In a litter of four puppies under observation at the present time, two of the animals recovering from spontaneous rickets and on a stock diet show marked odontoclasia. The other two, on an experimental diet designed to induce skeletal defects, have good teeth.

Smears and cultures were made from the teeth of one of the animals showing odontoclasia, and examined as a preliminary exploration. The smears revealed a great variety of gram-positive and gram-negative organisms. Cultures were made in broth tubes at p_H 5 and p_H 7. In the former, *B. acidophilus* and *B. acidolacti* grew, and later *B. coli* was found. In the latter tube, a great variety of organisms were grown, *B. coli* predominating.

ETIOLOGY

The hypothesis that conforms best with the findings to date is that odontoclasia is the result of an oral bacterio-

chemical complex associated with that systemic condition which accelerates calcification in the long bones of the growing child and the dog.

If analogies can be drawn from the ash analyses of new born puppies, which show that the mineral content of the bodies of representatives of litters which develop rickets spontaneously is markedly less than that of representatives of litters which develop normally under identical conditions of diet and hygiene (to be reported later), we can assume that infants with a rachitic tendency start out in life with a mineral deficit, and if calicification keeps pace with growth, the rate of the former must be accelerated. Concomitant with an increase in metabolic activity, destruction of the tooth substance appears to occur. Interestingly enough, the observations we have so far made on our experimental animals are in accord with clinical findings. Roughly classifying a group of forty-four animals, all of which were fed on a diet consisting of bread, milk, meat, butter fat and orange juice supplemented with various salt mixtures, twelve had odontoclasia in varying degrees, and thirty-two showed no evidence of this condition. Of the twelve with odontoclasia, four appeared to be normal as far as skeletal development was concerned, before and during the eruptive period of the permanent teeth (sixteenth to twenty-second week). Seven were in the healing stage of rickets and one was on a decalcifying diet, although retrograde bone changes were not observed during this period. The lesions in the latter animal were slight and were confined to the buccal surfaces of two lower molars and one upper molar. Of the thirty-two animals that did not show any evidence of odontoclasia, twelve were undergoing retrograde bone changes; eight were rachitic and in a static condition as far as calcification was concerned; eight apparently normal; and three in the healing stage of rickets, during the eruption period. Seventy per cent of the animals which were in a highly active state of calcification (recovery from rickets) during the eruption period developed odontoclasia to a more or less marked degree, and 33.33 per cent of the supposedly normal animals also developed it. Furthermore, the condition has never been observed in any of our actively rachitic animals, nor has it developed when retrograde bone changes have been induced subsequent to the eruption period. Correlating gross hypoplasia with odontoclasia, the two conditions seem to parallel each other, although the teeth of one animal with marked odontoclasia showed no macroscopic evidence of hypoplasia and those of another animal were markedly hypoplastic, yet showed no evidence of odontoclasia. From this, it seems that the two conditions are usually but not necessarily associated.

COMMENT

Lesions of the teeth that differ from dental caries in localization and in certain histopathologic characters have been observed in the mouths of dogs on experimental diets. The lesion is characterized by a destruction of the tooth *en masse*, rather than by the burrowing process more typical of caries. It differs from the latter also in that it advances through the tooth substance from without inward in parallel fronts, rather than in flamelike or coni-

cal extensions. It resembles the gingival third and senile type of cavities more than any of the other classes. To distinguish this manifestation of dental disease, we suggest the term "odontoclasia."

Hypoplasia, especially microscopic hypoplasia of dentin and enamel, is commonly associated with odontoclasia, but cannot at present be convicted of any etiologic rôle. It has been pointed out that microscopic hypoplasia of enamel and dentin are not necessarily associated and that the former, being less obvious, may escape detection.

Odontoclasia produces a form of destruction that it is very difficult to treat from the technical standpoint; hence, its prevention is of paramount importance.

Our search of the literature for reference to these conditions has given us the following impressions. Thorough studies of hypoplasia are presented in American writings, the consensus of opinion being that hypoplastic teeth are no more susceptible to caries than are normally formed teeth. J. Leon Williams has stated to one of us in conversation that he found the enamel of caries-susceptible human teeth to be no more subject to histologic defects than teeth of lower animals immune to caries. The German literature seems also to stress the structural aspects of hypoplasia rather than the syndrome with which this paper is concerned. But, in the English literature, our search was more fruitful. Dick[6] refers to the common occurrence of hypoplasia in rickets.[7] He goes on to describe the localization of hypoplasia of teeth of the permanent set. This part of his description conforms closely with the writings of Black and others. He states that the condition is almost pathognomonic of rickets and that rickets is the only condition which interferes with the deposition of calcium for a sufficiently long period to produce these deformities. Black attributes hypoplasia to a number of different agencies which may interfere with normal well-being or nutrition during the period of formation of teeth. His findings are well supported by abundant data and would seem to preclude the assertion that this condition is pathognomonic of rickets. Apropos of the effect on the enamel of teeth in rickets, Dick brings out the fact that a disturbance in function of the ameloblasts may lead to the enamel's being thin in parts or to the lime salts' being imperfectly laid down and hence more easily disintegrated. Either a thinness of the enamel due to the omission of accretions, or a faulty calcification of the enamel, in the opinion of this author predisposes to decay. Certain endocrine disturbances have been held responsible, at least in part, for the condition, but discussion of this factor must be left to a later time.

Dick points out that the picture of hypoplasia is frequently masked by a

6. Dick, J. L.: The Teeth in Rickets Proc. Roy. Soc. Med., 9: 83, 1915-1916.

7. The conditions in the teeth resulting from rickets are just opposite to those which are due to scurvy. In the former, there is progressive failure of calcification: first, incomplete calcification; then the formation of organic matrix alone, and, finally, cessation of development. In scurvy, it is the formation of the organic matrix that is first affected. In rickets, the tooth may present a large pulp and shelllike walls; in scurvy, the pulp tends to become solidified by the formation of pulp bone.

superimposition of caries. This is doubtless true. It will be necessary, therefore, in making these observations, to look particularly in the mouths of the younger children in order to study the uncomplicated cases. Dick feels that even where no macroscopic changes indicative of hypoplasia may be found in teeth of rachitic children, changes of a microscopic character may be distinctly effected. This view conforms with our data. He believes that pyorrhea is not associated with these conditions. Our findings have shown distinct pyorrhetic conditions, such as recession, detachments and pocket formation, with a variety of inflammatory reactions, associated with hypoplasia and odontoclasia. Dick states that the lesion which he describes is not a process of decay in the ordinary sense. With this, we concur. That the thin, defective enamel from the surfaces of the crowns of grinding teeth can be seen breaking off in flakes is probably not quite true. The falling away of the enamel flakes would indicate a detachment from the dentin. It seems, at least in our material, that the enamel is lost by progressive distintegration. The flaking away of masses of enamel might occur, owing to secondary extensions of injury following the dento-enamel junction; but the initial lesion is apparently not due to mechanical breaking away through any lack of union between the dentin and enamel, but rather is the result of some erosive activity.

In a discussion of Dr. Dick's paper, J. Sim Wallace refers to the work of other observers who believe rickets and caries to be not especially associated. He states that although rickets is very common, only a small percentage of children present hypoplastic teeth. His apparent assumption that caries of the teeth may be no more prevalent among rachitic children than nonrachitic, and his statement that hypoplastic teeth are not frequently affected by caries, are general observations which do not throw much light on the present problem.

Dick, in his reply, states that, to regard hypoplastic teeth as no more susceptible than good teeth, is not reasonable. As to this, we certainly do find in dental practice a remarkable freedom of such teeth from caries.

Broderick[8] speaks of a destruction of the enamel *en bloc*, which is characteristic of the lesion under discussion. He attributes it to loss of alkalinity in the saliva, and secondly to withdrawal of lime, which he apparently ascribes to an endocrine factor. But we are inclined to the feeling that the initial fault is developmental in origin and the subsequent lesion due to an exogenous particulate factor, related fundamentally to metabolism and more specifically to that systemic factor which promotes active calcification in the long bones of growing children and of dogs.

Finally, it should be recognized that, although the hypoplasia and the disintegration of the teeth seem to be closely related, varying lengths of time may elapse between the eruption of imperfectly formed teeth and their subsequent destruction.

DISCUSSION

Charles F. Bödecker, New York City: I welcome this investigation particularly because it gives further proof that the teeth are an index to the body conditions. The dentin and enamel are in connection with the general circulatory fluids and can therefore

8. Broderick, F. W.: The Endocrine Factor in the Production of Immunity and Susceptibility of the Teeth to Caries, Proc. Roy. Soc. Med., 15: 22, Odontol. Sec. 1921-1922.

be affected in health and disease. The wealth of material here presented shows an immense amount of work which I can well appreciate, and it will take considerable study to gain all the knowledge it contains and practically apply its teachings. The term "odontoclasia" as here suggested seems apt. This condition, luckily for us, is not at all common in man. I have had only one really grave case in twenty-six years, in an 18-year-old boy, whose teeth were almost completely disintegrated. He had consulted three dentists but all had refused to do any work for him. Technically, little can be done for patients in such an advanced stage of odontoclasia. The remaining enamel and dentin is then so disintegrated that the teeth will not retain fillings. Of practical importance is the early diagnosis of odontoclasia, in the sixth or seventh year, when the incisors and first molars erupt. We can then treat the systemic conditions by proper diet as well as attempt the remineralization of the teeth according to Head, Anderson and others, a method with which I have had some success. I share the belief that odontoclasia is the result of an exogenous factor and think that the predisposing cause is some endocrine disturbance, aggravated by an incorrect diet. With one point I am not quite in accord. Dr. Simonton and Dr. Jones distinguishes between two kinds of dentinal tubules in the teeth of their experimental animals; a coarse type and a fine type. To my mind, the error originates in the preparation of the specimens. Those that appear as coarse are air-filled tubules, while the fine type still contain their normal dentinal fibrils. That this is the case is proved by the statement that the coarse type appears white, macroscopically, except in the photomicrographs, where they become black. The reason of their appearing black is that the imprisoned air refracts the transmitted light; while those which contain no air allow the light to pass through without interception. A very important practical point brought out in the complete report of Dr. Simonton and Dr. Jones is this: The change from a clean to a filthy mouth is under the control of systemic conditions. This, I think, deserves the greatest emphasis. The fact that civilized man needs a toothbrush to remove the gelatinous plaques and food débris is, to my mind, a sign of our incorrect mode of life. Animals partaking of a normal diet have a "physiologically clean" mouth, and the veterinary surgeon regards the state of the mouth as an index of the general health of the animal. When the diet of experimental animals becomes abnormal, bacterial plaques and gingivitis soon appears. I used to think that such inflammations were caused by the lack of the normal, hard, fibrous food, but a new train of thought has been opened here in the suggestion that such insanitary oral conditions have a systemic cause. If we apply this thought while examining the mouths of people who use the toothbrush carelessly or not at all, we come to the conclusion that the majority of civilized beings are ailing. And it is true! Do not a great number suffer from a variety of slight ills, such as headaches, indigestion and constipation, from which they gain temporary relief by the use of medicaments, instead of by selecting proper food and taking a daily 5-mile walk? I wish to apologize for introducing the matter of diet into this discussion, but the importance and great practical significance of the suggestion and its relation to the development of sound teeth as well as good health seemed to warrant it.

T. B. von Beust, Louisville, Ky.: Dr. Simonton has well defined a condition heretofore undescribed and, in addition, has provided for it an appropriate name. Dental practitioners usually regard congenital enamel defects as hypoplasias. Today, our vision has been extended to certain differentiations. First, we find a macroscopic hypoplasia, with loss of tooth structure, often involving a zonation (with or without loss of tooth structure), distinguished from a microscopic hypoplasia. We then find a disintegration of the affected areas due to mechanical agencies distinguished from a disintegration through lytic or clastic agencies. Heretofore, we have been prone to attribute progressive loss of substance in hypoplastic teeth to attrition. A hypoplastic tooth with discolored labial plate in a child, for instance, frequently becomes white and translucent by the time maturity is reached. Again, a hypoplastic molar loses its enamel progressively until we are obliged to provide a crown, or, in cases of cuspal hypoplasia, where only superficial enamel is affected, we see the cusp "wear" down to translucent enamel. Today, we have been made acquainted with the chemical or clastic form of dissolution. The mode of attack

manifested by the etiologic agency, which affects the largely organic interprismatic substance first, appears to justify the interpretation of the authors that the etiologic factor is a microbial lysin or possibly it is a product of zymogenes. While clinical observation may finally solve the question as to whether the odontoclasia is dependent on a macroscopic hypoplasia, I fear that it would be premature to consider the so-called microscopic hypoplasias in their relation to the lesion. Observers are not yet agreed concerning the interpretation of certain enamel structures which by some are regarded as normal, by others as hypoplasias. The "tufts," for instance, have long been regarded, and still are, by some, as the results of undernourishment. Opinions concerning the histopathology and etiology of hypoplasia differ widely. It has been contended that an influence inducing a hypoplasia must affect the whole then-forming enamel layer, yet microscopic examination of teeth that exhibit hypoplasia shows the affection extending through many of the otherwise healthy layers. Moreover, the theoretical enamel layers which manifest themselves as the striae of Retzious do not, according to some authors (Caush, von Beust), exist at all. Concerning the hypoplastic dentin, we are in no better position. Interglobular spaces, even those exhibiting the lines of Zerma, are so common in the teeth of lower animals (also of wild animals) that we should not include them as a manifestation of hypoplasia. Of course, a superabundance of these spaces (beyond a normal, which has not yet been established) would justify a diagnosis of hypoplasia. Variations in the lumen of the dentin tubules, assuming that I am interpreting correctly the descriptions here presented, commonly occur in both man and the lower animals. These may occur both singly and in groups. The same remark applies to the wisplike splitting and expansion of the dentinal tubules at the periphery of the dentin. The conclusion that the odontoclasia is posteruptive appears established. Judging by the descriptions, the lesion, as regards its histopathology, shows a resemblance to mottled enamel. Concerning the susceptivity of defective enamel to decay, I endorse the words of G. V. Black, who stated, that "neither the density, nor the percentage of lime salts, nor the strength, is in any degree a factor in predisposing teeth to caries." Black goes yet farther, contending that defective tooth structure will not hinder its progress. Of this latter view, I am not convinced. The essay, as presented, is a valuable contribution to our literature and offers much material for thought and investigation.

THE SURGICAL TREATMENT OF PERIODONTOCLASIA*

By ADOLPH BERGER, D.D.S., New York City

THERE are two operations and their modifications that are practiced for the relief and cure of the pathologic conditions generally known as pyorrhea alveolaris or, more recently, as periodontoclasia. The operation first practiced is known as gingivectomy; the one more recently employed, as the radical or flap operation.

The operation of gingivectomy dates back to the time of Riggs. Black,[1] in his work on special dental pathology, ascribes the operation to Riggs. He says: "His (Riggs') operation for the cure of these conditions was very simple and without differentiation between the inflammations caused by salivary calculus and those in which pus pockets were formed. In practically all cases, the treatment was the same, except as to the extent of cutting required. The gingiva and gum tissues were cut away sufficiently to remove all diseased tissue to the line of attachment of the peridental membrane."

In a personal communication, Arthur H. Merritt[2] assures me that Riggs did not practice this operation. Merritt, in his search through the literature, has found that Riggs expressed the opinion that the operation is barbarous. This opinion prevails at the present time among numerous discriminating men.

Black practiced and advocated, in a measure, the removal of the gingiva and gum tissues for the purpose of eliminating the pus pocket. He did not approve of this method as a practice for the general treatment of pyorrhea. Still, within recent years, the operation has gained a considerable number of followers throughout the country.

The second so-called radical or flap operation, which is of a more recent date, has gained a considerable number of votaries within the past five or six years. In this operation, the pathologic area is visualized by raising and everting the gums and the overlying mucoperiosteum well beyond the diseased parts. Under the guidance of vision, all irritating factors, the granulation tissues that line the pockets or fill the bone cavities produced by the chronic suppuration, and all so-called necrosed bone are removed. The gum flaps are restored next and sutured into place. The more methodical advocates of the operation insist that it should be preceded by the removal of all exogenous irritating factors, and the correction of such conditions as conduce to the formation of pyorrhea.

*Read before the American Academy of Periodontology, Philadelphia, Pa., Aug. 20, 1926.

1. Black, G. V.: Special Dental Pathology, p. 66.

2. Merritt, A. H.: Personal communication to author.

There are several men who claim originality and priority for this operation. Among others, we may mention Robicsek, Gottlieb, Widman, Neuman and Zentler.

I have read a number of articles published since 1919 dealing with the subject in different periodicals, but the only complete work which has been brought to my attention and which I have had occasion to peruse is a small book, now in its fourth printing, by Robert Neuman[3] of Berlin.

Neuman states that he has been practicing flap operations for the treatment of pyorrhea since 1912. He also claims that he was the first one to establish this operation upon a systematic and rational basis and that no such work was presented to the profession before 1914. As he is one of the most ardent exponents of the surgical treatment of pyorrhea, much in this paper is based upon his work, so that it may almost appear to be an analytic or critical review of his book.

In looking over the voluminous literature dealing with the subject of pyorrhea alveolaris, one is impressed with the diversity of opinions as to the etiology, the pathology and the classification of the morbid conditions included under this disease.

To Harold K. Box[4] belongs the honor of having presented to the profession one of the most scientific, and therefore most creditable, descriptions of the initial stages of the morbid processes that usually lead to the formation of true pyorrhea. His work is valuable not merely because it is so preeminently clear but also because his description of the pyorrhea pus pocket is corroborated with competent research work, and, further, all this is so much in accord with the clinical phenomena, when these are closely observed.

The publication of Box, dealing with the formation of the pyorrheal pus pocket, is a piece of classic, scientific research which, being corroborated by the histologic specimen, is hard to contradict. As a result, the entire problem becomes much simplified, clean cut and comprehensible. Moreover, as stated before, his findings in this respect are in fairly complete accord with the clinical phenomena. This makes it so convincing that it can easily be imparted to students or whoever wishes to learn this: that the development of pyorrhea depends frequently upon a break in the delicate protective epithelial surface lining the gingival crevice. Not ignoring possible constitutional factors, with such a clear-cut conception of the immediate causation of the disease, much can be done in the way of prevention and rational treatment.

I believe, as does Bunting, that the early treatment of pyorrhea, and its prevention, lie in the hands of the average general practitioner. The prognosis in the treatment of pyorrhea decreases with its advanced state. Bunting[5] states that "In the great majority of cases of incipient pyorrhea and those in which the disease has not progressed to a hopeless stage, the thorough removal of all irritants and stress from the teeth and contiguous tissues will stop the progress of

3. Neuman, Robert: "The Treatment of the So-Called Pyorrhea and Other Periodontal Affections."

4. Box, H. K.: Evolution of Periodontal Pus Pocket, J.A.D.A., 8: 599 (Aug.) 1921.

5. Bunting, R. W.: Dent. Cosmos, 62: 737 (July) 1922.

the disease, even in the presence of constitutional susceptibility."

It may prove to be a disadvantage to introduce such elements into the problem as will tend to make an already intricate matter too difficult for the average man to grasp or to master, and the natural tendency will be to shirk all responsibility in this respect. This at once opens the way to a contrasting psychologic state and misunderstanding between the dentist who feels that the detection, prevention and treatment of pyorrhea is a hopeless task and the patient who is eager to preserve his teeth.

In order to understand more closely the principles upon which the flap operation is based, it will be necessary to review briefly the modes of diagnosis by Neuman and the classification he uses, which he credits to Weski. He divides the cases into (1) horizontal and (2) vertical. In horizontal pyorrhea, the bone becomes resorbed parallel to the upper margin of the alveolar process. In vertical pyorrhea, the pocket formation is parallel to the long axis of the tooth.

He considers this classification important from the standpoint of prognosis and therapy. He holds with Weski that clinical experience shows that horizontal pyorrhea is more amenable to treatment than is the vertical type. Since the prognosis in the horizontal conditions is so much more favorable, the aim in our treatment should be to transform vertical pyorrhea into the horizontal kind.

Cases are further classified under (1) total atrophy, and (2) partial atrophy. Under the heading of total atrophy are those cases in which there is relatively uniform absorption of the alveolar process and the soft tissues. The atrophy may be adolescent or senile.

Neuman advocates that all cases be diagnosed by radiographic examination. He attaches much importance to the probing of the pockets with guttapercha points. The radiogram is taken with the guttapercha points in position wherever they can be inserted.

In total atrophy, guttapercha points cannot be introduced and there are no pocket formations. The treatment indicated is the elimination of all endogenous and exogenous irritating and disturbing factors. The partial atrophies are characterized by the unequal absorption of the bone and of the soft tissues. These are classed into two groups: (a) those of the nonpyorrheic type, in which the pocket walls are not ulcerated, and (b) the pyorrheic type, in which the pocket walls are ulcerated.

On the basis of this classification, which is only partly presented here, the following clinical pictures are described and the treatment is prescribed:

1. Horizontal atrophy of the alveolar process:

(*a*) With superficial pockets. A guttapercha point cannot be inserted.

Treatment: Removal of all endogenous factors and exogenous irritants; gingivectomy, and cauterization.

(*b*) With deep supra-alveolar pockets. A guttapercha point may be introduced to the bone.

Treatment: Remove all endogenous factors and exogenous irritants. If the pocket is only 2 mm. deep, the following procedures are advocated: (1) curettage; (2) gingivectomy; (3) use of actual cautery; (4) radical flap operation. If the pocket is more than 2 mm. deep, only the last three methods can be used.

2. Vertical atrophy of the bone:

(*a*) With superficial pockets. Guttapercha cannot be inserted. If the pocket is more than 2 mm. deep, only radical surgery should be employed.

(*b*) With deep supra-alveolar pockets Guttapercha may be inserted to the upper

surface of the bone. Removal of the gingiva to the bone surface may be carried out, but radical surgery is the surest way.

(*c*) With deep intra-alveolar pocket. Guttapercha point may be inserted to the bottom of the pocket. The only way is radical surgery.

In true pyorrhea, the same conditions may prevail as far as tissue destruction is concerned.

Besides the corresponding atrophic changes, there are ulcerations and cavernous pocket formations. These, of course, can be handled by radical surgical means only. From these, it will be seen that there are only two types of conditions that may be treated in a conservative manner. These are classed as complete or total atrophy, and are characterized by a uniform absorption of the alveolar process and the soft tissue. In these cases, there are no pockets and guttapercha points cannot be inserted.

According to Cieszynski, the following advantages may be derived through the radical flap operations:

1. They visualize the field of operation and facilitate the thorough removal of the calcific and serumal deposits from the roots when exposed.
2. The radical removal of the granulation tissue together with the epithelial strains which may be present in the gum tissues which form the pockets.
3. Removal of projecting bone rims of the alveolus and the smoothing of their surfaces.
4. Disinfection of the diseased parts.
5. Radical removal of the gum packets which are the sources of pus formation.
6. Reducing the gum papillae with a funnel shaped incision so that it is diagonal to the tooth. By this incision the epithelial covering on the inner surface of the gum is removed and the exposed connective tissue surface is reduced so that no hypertrophied granulation may follow. In this way after the tissues are sutured a new gingival ligament is created.
7. This operation should be performed with a scalpel and curettes and not with a cautery as with this instrument unfavorable cicatrization may be produced.
8. The alveolar process which was practically destroyed by the progressive disease after cicatrization is removed. The teeth nevertheless become much firmer because of the contraction of the mucoperiosteum.

Neuman states that the following are the requirements of a successful operation.

1. A clear visualization of the field of operation.
2. The diligent removal of all concretion and deposits from the roots.
3. The complete removal of bone protuberances and nooks concealed by epithelium and the contained masses of granulation tissue.
4. The complete removal of all bone tissue which is incapable of regeneration.
5. The removal of all undermined bone projections and obliterating the cavernous cavities formed.
6. The disposing of the pockets by reducing the mucoperiosteum to the healthy bone surface.
7. The transformation of the vertical pyorrhea into a horizontal one.
8. Covering the healthy bone surface with healthy gum tissue so that the ideal state of total atrophy may be secured.

What constitutes a cure according to the best conception of the practice of periodontia? The more important points may be summed up under the following items: (1) removal of all local irritating factors; (2) correction of abnormalities which may act as etiologic factors, such as occlusal stress and lack of points of contact; (3) attention to possible constitutional conditions; (4) elimination of inflammatory processes affecting the periodontium; (5) elimination of suppuration; (6) elimination of the pus pocket, and (7) the tightening of the tooth.

When these results are attained, the case is considered cured, from an objective or subjective standpoint. Satis-

factory results are not fixed entities. Thus, some men are satisfied when a copious flow of pus has been reduced to an occasional drop and if a loose tooth is rendered less loose. Even with the best efforts, this may be all that can be attained in some instances. The measure of success in the treatment of a case is always gaged by the degree of success in the above enumerated considerations.

Some men go beyond these in their expectations and strive to induce bone regeneration and a more or less complete reconstruction of the alveolar process or the periodontium as a whole. No doubt, some degree of repair and regeneration does follow, as it is in the nature of all tissues to undergo repair and most tissues to regenerate to some degree. But it is questionable whether complete reconstruction of the alveolar crest ever occurs or there is complete restoration and normal coordination of periodontium and the cementum.

The elimination of palpable pus is often accomplished by the simple expedient of removing the local irritating factor. The elimination of the pus pocket, an equally important requirement in the curing of a case, is not easily attained. With the understanding of the pathology or pocket formation, we realize that this difficulty lies in the nature of the tissues and is inherent in the damage caused, and cannot be entirely controlled by the skill of the operator. The pus pocket may be eliminated to a variable degree through the regeneration of the involved tissues, but the major part of this obliteration is, as a rule, merely a physical one.

The men who practice the flap operation argue that, although the elimination of pus is important, it must be regarded as a secondary consideration in the curing of the disease, and that the presence of pus has only a negligible bearing on the theraputic measures used. This view bears the implication that the treatment must be the same whether there is pus present or not.

Neuman concurs with Weski in the view that all reports published in which the claim of a cure is based upon the elimination of pus should be regarded with a great deal of scepticism as the stopping of the flow of pus is not the equivalent of a cure. He claims that the simple treatment of the pocket walls and the pocket contents is sufficient to relieve the tissue immediately surrounding the pus collection and to stop the flow of pus. The result to strive for is, in his estimation, self-evident. A cure should be attained by creating a topographic relationship of the mucosa and the underlying bone which will be indentical with complete atrophy, with the only difference that the epithelial attachment is no longer located at the cemento-enamel junction but on the cementum proper. (Weski.)

With some modifications, such a result may be attained with the flap operation. If such a result carried with it a reasonable assurance of permanency, one could be well content with it.

There are several questions which obtrude themselves at this point. The first is, how long does this newly formed attachment remain? We know from experience that pyorrhea has a great tendency to recur even under favorable conditions, and especially so when the basic etiologic factors are not removed or remedied.

To touch on one point: In vain does Neuman try to reassure us that the healing of the parts after a flap operation

follows just as readily in the presence as in the absence of endogenous factors. He maintains that with the energetic treatment of the local lesions, the endogenous factors have no longer sufficient force to revive the local pathologic picture.

Such reasoning is futile and is but a poor crutch to prop up a doubtful issue. It seems more reasonable to assume that those agencies that were capable of undermining or impairing the integrity of the periodontium when intact will be even more potent in undermining an impaired portion thereof despite energetic local treatment.

Whatever the immediate results of the operation may be, we cannot regard this new condition as a permanent state. We must consider, therefore, the later result and what our treatment should be in case of recurrence. According to the principles expressed, it must be another operation. Should we not ask, then, how many operations can be performed when some amount of bone must be removed at each time in such a manner that repair and regeneration is rendered impossible?

A common failing of the men who have adopted operating for the general treatment of pyorrhea is that they are remiss in the preliminary treatment and also in the postoperative care of the cases. They frequently fail to eliminate the etiologic factors; and yet, we know that all, even the most incipient, conditions require constant care in the way of preventive measures on the part of the patient and also the operator. Such care becomes even more important under the circumstances, when the tooth is robbed of its protecting device, which Nature provides through the gingiva and its adaptation to tooth form. The preservation of this tissue is of extreme importance for the welfare of the tooth. Indeed, Merritt[6] states that the most important function of the gingiva is protective, and this is accomplished by "protecting the cervical enamel in such a way that it completely fills the interstices between the teeth and terminates in a sharp dense edge of such a shape as to shed off and prevent food lodgment." He also maintains that the rigidity of the teeth in their alveoli and their normal relation to each other and to the teeth in the opposing jaws are due more to a healthy gingiva than to the alveolar process. While the accuracy of this last estimate may be open to discussion, by inference the importance of the gingiva in the maintenance of the tooth is not overstated.

Black[7] says:

> As soon as those fibers which pass from tooth to tooth or from tooth to alveolar process are involved, tooth movement is apt to begin. The gradual movement and separation of the teeth present the greatest difficulty in management, because the opening of the contacts invites food impaction, which causes sufficient irritation to keep up a low grade of inflammation, even though the patient gives the best possible care by prompt and thorough cleansing.

It is fallacy, therefore, to regard this operation as a means for bringing about a permanent cure. In this respect, the operation cannot be compared with an appendectomy or some other operation in which a diseased member is removed, and the condition terminates with the cicatrization of the wound.

The exponents of all methods of operation are agreed on the need for

6. Merritt, A. H.: Etiology of Periodontoclasia, J.A.D.A., 7: 295 (March) 1920.

7. Black, G. V.: Footnote 1, p. 26.

eliminating the following: (1) all exogenous etiologic factors; (2) all degenerated and granulation tissues; (3) all so-called necrosed bone and infected cementum.

There is some difference in the operative principles of the exponents of the flap operation. Neuman believes in the surgical removal of all granulation tissue and necrosed or infected bone and in converting vertical pyorrhea into the horizontal kind. He further advocates the elimination of the pocket by trimming the gum flaps and suturing these closely over the remaining healthy bone. In this way, the histologic relationship of the involved tissue more closely resembles the normal condition.

Zentler[8] does not follow this method in all its detail. In his modification of the operation, the gum flaps may project beyond the bone surface and the cicatrical contraction of the tissue is depended on for the elimination of the pocket. He states that when cicatrization ensues, the finest probe cannot be passed.

Much stress is placed on the importance of the removal of the granulation tissue adhering to the inner surface of the gum that forms the pocket, and often penetrates the excavated alveolar process. This tissue is classed by some with the granuloma that occurs at the ends of infected roots. I doubt the accuracy of this comparison. Clinically, these tissues appear to be sickly, soft, poorly organized, very friable and loose in texture. They do not appear to form an organized entity as does the granuloma. Histologic examination shows that they are here and there pervaded by epithelial chains. These may be derived from the surface epithelium, but more likely arise from the epithelium of the gingival crevice or from the epithelial chains of the periodontal membrane.

This type of tissue is often found to develop about necrosed bone or in chronic suppurative areas. It is common clinical observation that, with the removal of the irritating factor, this sickly tissue proliferation has a tendency to become resorbed. This is true whether it develops about the end of a root, about a portion of necrosed bone or in an ulcerative pyorrhea pocket.

Some of this tissue breaks down and is transformed into pus; some may undergo autolysis, and a considerable portion may be destroyed by the activities of the phagocytic cells.

To those who have had the opportunity to treat and closely observe cases of necrosis, this is not an unfamiliar phenomenon. In these cases we often see retrograde changes and the resorption of such tissue proliferation on the removal of the etiologic factors.

A case, which though different in many respects, is nevertheless analogous, is reported herewith.

REPORT OF CASE

A man, aged 48, had acquired syphilis about twenty years previously. He received good medical attention and the periodical blood examination made at the indicated intervals was negative. He was feeling well until about five months before he came in, when his upper anterior teeth became sore, although they were free from caries. Later, the gums, lips and cheek became swollen. The teeth were removed, but this gave only slight relief. On examination, it was found that the mucosa on the labial and palatal aspect was considerably swollen and discolored, and so distended that the involved part was at least three times its normal thickness. There were several perforations or sinuses through which pus exuded profusely. Tissue proliferations extruded through these open-

8. Zentler, Arthur: Internat. J. Orthodon. 5: 586 (Oct. 1919).

ings and, on palpation, the part felt like a semisoft rubber ball; which indicated the abundant proliferation of morbid tissue. The clinical picture was so extreme that the syphilologist who examined the patient was unable to decide whether we were dealing with a gumma or an epithelioma. The recent history and the acute symptoms did not suggest malignancy. The unusual enlargement of the parts, however, and the large amount of tissue proliferation were somewhat typical of a new growth. Radiographic examination revealed the presence of considerable necrosis, involving the greater part of the anterior portion of the alveolar process and a considerable portion of the maxillary bone.

I have seen numerous similar cases, though not always associated with syphilis. This made me feel that the condition was not malignant and that the hyperabundance of tissue proliferation was the result of the inflammatory reaction called forth by the irritation of the necrosed bone and the suppurative process. The case was treated with the simple measure of irrigation, and the necrosed portions of bone were removed, as they were exfoliated. No curetting was done to remove the morbid tissue, and, with the exfoliation of the necrosed bone, suppuration ceased, and the granulation tissues were eliminated.

Such a condition is not similar to a pyorrhea pocket in all respects, but it bears a strong suggestion that, with the elimination of the exciting factors, these sickly granulation tissues becomes liquefied, resorbed and eliminated, and replaced with good repair tissue.

One of the strong points of Neuman is that since horizontal pyorrhea is a more favorable condition for treatment than the vertical type, the aim of all treatment or operations should be to transform all cases into the horizontal type. Let us study this suggestion for a moment. This proposition implies that the gum line should be reduced to a uniform or nearly uniform level. To be exact in conforming to this, we must first remove all of the presumably necrosed or infected bone on the diseased tooth and reduce all of the alveolar process, whether healthy or diseased, to this lowest level. The damage wrought with such a procedure can be realized only if we consider the difference in the degree of the tissue destruction on the different surfaces of one tooth or on the different teeth. The tendency is to reduce even the normal parts to the state of the poorest portion of the alveolar process instead of encouraging repair and regeneration of tissue and thereby attempting to produce a condition that would tend to reestablish a more normal state.

No comment is necessary to discredit such a procedure even if we should not accept entirely the findings of Black, who maintains that no reattachment of the pericementum follows after this has been detached by a pocket formation from the cementum. Exception to this view is taken by McCall on the ground of clinical, or rather radiographic, findings that bone regeneration has been observed following the successful conservative treatment of pyorrhea. This does not contradict or invalidate the findings of Black, who was one of the most accurate and keen observers. I believe that both of these men may be right.

The periodontal membrane is a highly specialized tissue, which, like all specialized tissues, can undergo repair, but has only a limited power of regeneration. The cementum cannot repair or regenerate itself as it is laid down and repaired by the periodontal membrane. We should be able to conceive of a stage in the degeneration of these tissues when they may appear to be altered or destroyed in the radiogram, when they are damaged merely to such an extent that repair and some degree of regeneration is still possible.

I believe that it is these tissues which still retain their viability and the capacity to repair on the removal of the etiologic factors that the careful periodontist must foster, for the proper manipulation of these tissues spells success or failure in his work. Beyond this, we must not, and reasonably cannot, hope. It is not in the nature of connective tissue to grow cementum or pericementum, and those who build upon such false hopes are doomed to be disappointed.

In surgical operations all of these tissues and much healthy tissue are further damaged or summarily removed. It is impossible to determine clinically just which tissue cells are destroyed beyond hope and which are still capable of repair and regeneration.

I do not believe that there is, in a pyorrhea pocket, necrosed bone, in the true sense of this term, as there is no line of demarcation or separation. There is necrosis in the sense that there are some dying or dead bone cells. Also some portion of the bone is permeated by the agencies of infection and by substances that result from a chronic suppurative process, but this is not essentially all dead bone. With this operation, much of this damaged but still viable bone and much healthy tissue that comprises the periodontium are irretrievably lost.

The pus pocket is at least temporarily eliminated, with this operation. How soon recurrence takes place it is difficult to state. I have seen some cases in which new pockets formed two or three months after the operation. The result is especially precarious when a partial denture which rests against the teeth is worn by the patient or when the patient is unable or unwilling to cooperate to the fullest extent in keeping the parts clean. I do not include in this group the types of cases in which the gums are wantonly resected for the cure of a mild case of gingivitis. I am here speaking of cases of true pyorrhea, in which the periodontium has been impaired and the cementum infected from one-third to one-half the depth of the root.

It should be of interest to know what the end results are from three to five years after operation in these cases, and this should be the object of our investigation. The photographs taken soon after cicatrization has taken place, showing favorable results, are no criteria. I have found, as all other men must have found, that the soft tissues heal promptly with no untoward complications but bone regeneration does not follow. This must be so since, in the operation, the cells that alone can repair or regenerate bone are removed or destroyed. This also explains why Neuman insists on the frequent or common use of splints and why he advocates producing and applying these prior to the operation.

Surgery has a definite place in the treatment of true pyorrhea, but the great majority of cases will yield better and more permanent results with competent root scaling and conservative local treatment. To prove this, I should like to suggest that the following test be made. Let there be several cases taken under treatment, and one-half of the mouth be treated by the conservative measures and the other with the flap operation. I venture to predict that, conditions being equal, the teeth scaled will present a much more favorable clinical picture and will be on duty long after the other will have been lost.

DISCUSSION

F. C. Pague, San Francisco, Calif.: All deep pockets, in my practice, are eliminated by surgical treatment. I do not mean that we start from the third or second molar on one side and continue to the second or third molar on the other; but from radiograms which I have made before I undertake my work, radiograms of every tooth in the mouth, I know the depth of each pocket. I know that if those radiograms have been taken perfectly, underneath that gum is a pathologic condition that the radiogram does not truthfully tell. I do not understand how periodontists who simply take these cases under treatment can expect healthful results from instrumentation without any thought of eradicating the pathologic conditions that exist in the bony process. And yet we see it on every hand. After the roentgen-ray diagnosis and a decision on the part of the patient to permit the work, I go over every tooth and as nearly as possible correct the traumatic occlusion. I then feel that my efforts, as far as the surgical work is concerned, will be a success. However, to attempt any surgical work before the correction of the trauma cannot result in other than failure. I don't treat all cases surgically. Where we have the narrow perpendicular pocket, it is not necessary, but we are dependent entirely on our sense of touch, and if that is cultivated to the sense of feeling that it should be, it is easy to remove whatever irritation there is on the roots of the teeth. Since 1894, I have been interested in periodontic conditions. William J. Younger of San Francisco was instrumental in my first thought in connection with such treatment. You may be able to appreciate the great change that has come about in treatment, from a simple instrumentation, as Dr. Younger had suggested or advised, to the surgical eradication of all pathologic conditions.

T. Sydney Smith, San Francisco, Calif.: We can get a vital reattachment of the separated tissues to the roots of the teeth. If that were not possible, then we would have to resort to extractions or to the surgical removal of all the tissues down to the level of the floor of the pocket. We must get rid of the pocket, but is it possible to get the soft tissues to form that vital reattachment to the root which will continue for fifteen or twenty years? I have cases that in more than twenty years have had no sign of recurrence, pockets that had been from 8 to 12 mm. deep. If we can get that result, should it not be the first thing that we would attempt? If we fail in that and continue to fail, then we must get rid of the pocket by any possible means. We run into great difficulties for the patient when we denude any of the root of the tooth. If we find the cementum already exposed it would be a miracle if we could stretch the tissues up, but if, through our methods of operation, no matter how honest we are in our intentions, we denude even a millimeter of the cementum and leave it denuded, a serious defect results. The cementum is so thin that the least bit of instrumentation in future prophylactic work, the necessary brushing (and if cementum is exposed, a much greater amount of brushing is required to clean it, because it is more porous, and it is more difficult to reach), if you brush with any method that has been suggested, will result in some abrasion that will count very seriously as the years go by. So I would advise you to resort to the surgical work of the removal of the gum only when everything else has failed. That would probably be years after you have started, because sometimes you will meet the conditions that prevent the reattachment, the removal of cementum. If a little piece of cementum is removed and the dentin exposed, the gum does not reunite to it. I should attempt to eliminate the condition gradually, and resort to surgery last.

Olin Kirkland, Montgomery, Ala.: I agree with Dr. Berger that all necrotic tissue should be removed from periodontal lesions if we expect to get lasting and permanent results. I agree with all that Dr. Pague has said in his talk. There is just one point in which I differ from Dr. Berger in his operation; that is, the extreme trauma produced in performing this operation. I have followed the surgical treatment of this condition over a period of eight years, and my observation is that the cases treated, although they show a certain amount of absorption or recession of the gingiva, have remained cured if the patient has properly kept the mouth cleansed and stimulated. My idea of the operation differs from Dr. Berger's in that I suggest simply making a mesiodistal incision, incising the gingiva merely to the depth of the diseased area, then thoroughly curetting the bony

septum involved, and the root surface of the tooth. Then with a simple suture from lingual to labial or buccal surface, as the case may be, we bring those tissues back together, and there is little trauma, almost none at all, and the operations are usually painless or almost entirely so. There is little bad postoperative effect according to the statements of my patients. I have found this method of treatment very satisfactory in my practice over a period of eight years.

Howard Stewart, New York City: What we have heard this afternoon only emphasizes that each man must operate according to his own methods and his own ability. The one thing the average man should keep in mind is this: We should take each thing that is good that each man has and not attempt to treat all cases alike. We have been full of fads in regard to the treatment of pyorrhea. It used to be that it was all calculus, you know. Then we had the Fletcher method of the alveolar bone. Each man produced results. We had the gouty diathesis theory and that sort of thing and the systemic treatment, and we all became enthusiastic over emetin. Then we all began to scrape cementum; and then we cut the flaps away according to the Black method. Now we have the operation that we have seen this afternoon. So I say that the one thing the average man should combine all these things and get the good from each one.

Arthur H. Merritt, New York City: The honors seem to be about even here today between what might be called the conservatives and the radicals. Last year, as the representative of the New York Academy of Dentistry, I was asked to obtain through a questionnaire the opinions of the leading men in periodontia throughout the United States and Canada on this particular point among others. I sent out ten questions and among them a question relative to whether it was desirable to resect the gums or perform the so-called radical operation. Fifty-three men were selected, most of whom were known to me personally, and known to be doing excellent work. I received forty-one replies, of which thirty-seven were outspoken in their approval of the more conservative method. There were four men who were more or less in favor of the more radical methods outlined here today. Now I think that that is a fair representation of periodontia as it is represented in the Academy and as it is being practiced by the best men throughout the United States and Canada today. I approve of every word that Dr. Berger has said when he has expressed his own opinion, and I am sure he concurs when I say that the much more satisfactory method must always be the one in which we can get the best results with the least amount of mutilation.

CONSTRUCTING ARTIFICIAL DENTURES BY DOUBLE IMPRESSION TECHNIC, DISCARDING MODELS MADE FROM FIRST IMPRESSION*

By CHARLES L. ALEXANDER, D.D.S., Charlotte, North Carolina

IT has been our custom for years to give a good deal of thought to the methods in vogue in our profession, both in operative and in prosthetic dentistry.

Many have made discoveries and improvements in the various branches of dentistry, and, as a consequence, within a very short period, the profession has advanced from a most primitive condition to a position that has attracted the attention of the intelligent world, placing dentistry in the foremost rank of the learned and scientific bodies, especially those dealing with the comfort and health of mankind.

Intuitively, we are prone to think that our endeavor has reached its zenith. This idea is a great error, and it should not hinder us from making an effort to reach the goal, which will not be final until the end of time.

I am presenting for your consideration a most simple improvement in the technic of the method that has been in use for more than half a century in constructing rubber dentures. The perfection attained is striking, yet the method is so simple as to cause surprise that the idea did not occur to some one many years ago.

I call the method the double impression technic in constructing artificial dentures. By the adoption of this method, the first, or preliminary, impression requires little or no care as to its accuracy. Therefore, it can be made in less than five minutes in the usual way, with modeling compound as a material for the impression. From this impression, a plaster-of-Paris model is made, upon which the form for getting the bite, and the base plate, are procured. To aid in getting the teeth set to position and in approximate occlusion, any articulator on the market can be used.

I am of the opinion that there never will be a mechanical articulator made to serve the purpose and give correctly all of the individual movements of the mandible. For this reason, I do not stress the use of any special articulator. With my method, the mechanical articulator is a necessity, but only as a stepping stone in the technic of construction. The base plate upon which the teeth are set up is a very rigid material withstanding all of the stress it is subjected to in the process of getting the final occlusion within the mouth after the plate and teeth have been removed from the articulator.

The direct method of getting a natural occlusion is obtained by slightly

*Read before the Section on Full Denture Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

heating the teeth and the paraffin wax which unites them to the base plate. This is a step which requires care. The

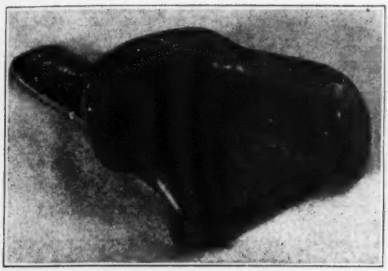

Fig. 1.—Snap impression.

heating is done with a gas or an alcohol flame, care being used not to heat the base plate, which would cause warpage, and thus interfere to some extent with the success of the procedure. After heating, the piece is placed in the mouth and held, if necessary, with an adhesive powder, the patient is

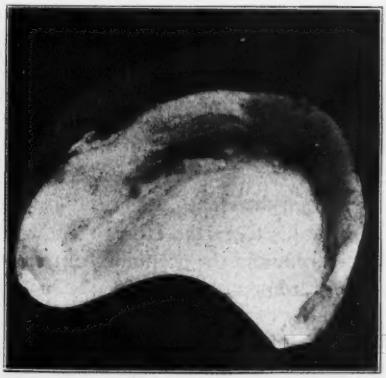

Fig. 2.—Model made from snap impression. This model is discarded.

instructed to close firmly, pressing the teeth into occlusion, then forward, and laterally. With these mandibular movements and with the aid of digital manipulation, while the parts are still

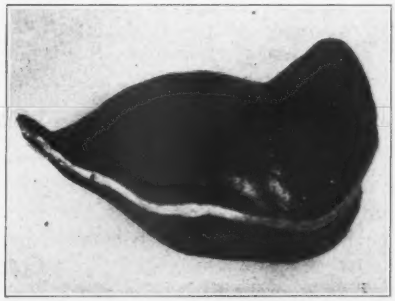

Fig. 3.—Base plate made on model used for setting up the teeth on the mechanical articulator.

plastic from heat, the teeth are positioned to a most natural occlusion. At times, it requires several heatings to get the best results. Since heat is applied to the outer or buccal surface of the base plate in getting the adjustment of

Fig. 4.—Plate showing teeth set up ready to be adjusted within the mouth.

the rim to the soft tissues, this part of the denture is not waxed up until the final adjustment is made.

When setting the teeth up in the articulator, I check up from time to time by placing the denture within the mouth. This is a great help in making the occlusion and positioning the teeth to give a natural expression. After the occlusion is procured, the articulator and models are discarded, having served their purpose. The denture is now placed in the mouth and notation is made as to periphery and arch adjustment of the base plate. The first thing to be done is to trim the base plate at all points indicating muscle interference. Then, the entire periphery should be gently pressed against the mucosa, greater pressure being exerted on the soft posterior palatal surface, the necessity of postdamming, heretofore done by trimming the model or waxing up the impression, being thus overcome. The palatal vault is also pressed gently to place. All of this adjustment is accomplished by heating that portion of the base plate which is under manipulation. The pressure is maintained on the parts being fixed until rigidity of the plate material is established by cooling.

Fig. 5.—Plate showing plaster impression within, also waxed up ready for flasking.

A little judgment and digital dexterity will "turn the trick." All heating should be done from the buccal and lingual surface to protect the patient from being burnt. We are now ready for the most important feature of this technic; namely, the second impression, which will give a perfect replica of the seating surface of the denture. This is done by taking an impression within the first denture, obtained as described above. A quick setting plaster is used for this purpose, the mixture being of a creamy consistency. A limited quantity is spatulated within the base plate, and the denture is moved rapidly and seated to position within the mouth. Since the base plate has been perfectly adjusted in the mouth, it is easily placed in exact position; therefore, there will be no change in the occlusion. In full-denture impression taking, the upper denture is first placed, then the lower. On examination, if care has been taken, the occlusion will not have been disturbed in getting this impression, as a test will show. This test is never made until the plaster has hardened. The plaster should set within two or three minutes after the denture is placed in the mouth, and it should be a very thin

Fig. 6.—Base plate plus the plaster impression material as removed from the flask.

mix to obviate the use of pressure in placing the denture in position in the mouth. If the inner surface of the base plate is dry and the mucosa wet, the plaster will stick to the plate instead of the mouth tissues on its removal. The plaster is dislodged by the patient's rinsing the mouth freely with cold water and forcing air within the mouth.

On removal from the mouth, the denture is allowed to dry out. Then the excess plaster is trimmed away, and a little hot wax is run around the rim to prevent the plaster from scaling off in waxing the piece up, etc. After the inner surface is treated with a thin coating of shellac, it is allowed to dry, and then the same surface is given a thin coating of sandarac, and when this is dry, the denture is flasked the usual way.

Before opening, the flask must be quite hot. The base plate wax and plaster impression material will then come out readily as a unit. The piece is then packed with rubber and vulcanized. The method applies also to partial dentures, giving these dentures such accuracy of fit when placed within the mouth that it is seldom necessary to use clamps. Accuracy of impression and the occlusion is the key to success in constructing full or partial dentures.

I also wish to emphasize the importance, from an aesthetic standpoint, of removing the furnace glaze from at least eight anterior teeth and repolishing these teeth. The repolished surface presents a most lifelike appearance.

By the use of this technic, an extension or lock can easily be made to the lower denture by allowing the base plate to extend well back into the retro-alveolar fossa, thus avoiding the use of special impression cups.

A MODERN CONCEPTION OF PROPER BRIDGE ATTACHMENTS FOR VITAL TEETH*

By K. W. KNAPP, D.D.S., Minneapolis, Minnesota

IF one were to name the *most important* consideration in the construction of fixed attachments for vital teeth, it is my belief that it would be the maintenance of vitality, during construction of the attachment and subsequently.

The evidence presented by laboratory research indicates that animals inoculated with bacteria from dental foci of infection in patients suffering from systemic disease show a decided tendency to develop the same disease. There is, at the present time, some controversy as to whether it therefore logically follows that these dental foci *are* the cause of the particular disease from which the patient is suffering. Yet, even those men who are investigating the possibilities of retaining certain pulpless teeth by proper treatment advise against such retention when the radiogram reveals evidence of apical absorption, or when the patient is ill from degenera-

*Read before the Section on Partial Denture Prosthesis (Including Crown and Bridge Work) at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

tive diseases, particularly of the streptococcal group.

Radicals and conservatives are united in the opinion that prevention of pulp involvement is, after all, the best cure. Rosenow says[1] that "a sane and comprehensive effort toward the prevention of septic foci in dental areas is a preventive measure of the first rank."

Other investigations have demonstrated the danger of vital but degenerated pulps as foci of infection. Rickert[2] points out the fact that, in extracting a pulpless tooth to remove a possible focus of infection and inserting a bridge, we may produce two foci in removing one, by causing pulp degeneration that results in metastatic infection.

For these reasons, the modern conception of proper attachments for vital teeth should first consider the possibility of making attachments in such a manner that there is no possibility of causing *either* degeneration or death of the pulp.

The pulp may be shocked to a point where it cannot survive in a normal condition in several ways: (1) by the shock of overheating during grinding; (2) by cutting too deeply pulpward; (3) by leaving dentinal tubules exposed to bacterial invasion and, thus, to infection, between the time of preparation and the time of setting the restoration, (4) by overdehydration before cementation, and actual dessication of the tubules, whereby cement liquid is forced into them to cause shock; (5) by overcompression of the dentin over pulps, from attachments that fit too tightly, and (6) by relying on the mistaken notion that cement is a nonconductor, and depending on it to reduce thermal shock where attachments are dangerously bulky.

The first important step toward conservation of pulp vitality under attachments would seem to be conservation of every possible bit of healthy tooth structure consistent with certain stability of the completed restoration. In other words, we should prepare our abutment teeth for the reception of attachments in such a manner as to prevent pulp degeneration, and yet insure that the bridge will stay in place for several years.

The inlay or onlay has been used as a bridge attachment for a sufficiently long period for us to recognize the fact, for it is a fact, that such attachments have proved themselves failures in a discouraging number of cases.

As a matter of fact, unprejudiced analysis shows, I believe, that the failures were due, not to the fact that inlays were used as attachments, but that they were improperly designed and constructed. In short, many bridges have come loose because the attachments had insufficient retention.

In order to study the relative stability of various forms of inlay and onlay attachments, we prepared a series of cavities in brass cylinders in which attachments were cemented and dislodged by the application of stress at a point where it would normally be applied in practical bridgework. The stress necessary to dislodge these attachments was measured by means of a mechanical device, and may therefore be taken as a fair test. The types selected for test were proximoclusal and mesioclusodistal inlays of the typical box-type form of

1. Rosenow, E. C.: Pop. Health Dent. Sup., August, 1926.

2. Rickert, U. G.: Laboratory Myths and Truths Regarding the Pulpless Tooth, J.A.D.A., 13: 477 (April) 1926.

preparation, three quarter and full cast crowns, and the slice preparation with lock anchorage, described elsewhere.[3]

An average of four tests are given and are represented in pounds necessary to dislodge the cemented attachments: proximoclusal, 58.1 pounds; mesioclusodistal, 40.3; three-quarter crown, 39.6; full crown, 72.1; slice preparation, 137.

Two types of cement were used, but practically no difference was noted. It may safely be stated, therefore, that the cement is not the deciding factor of stability under stress.

The gold used in these tests was of medium hardness and tensile strength, having a scleroscopic hardness of approximately 16 and a tensile strength of approximately 41,000 pounds per square inch. This type has been recommended as a desirable gold for three-quarter inlays and other bridge attachments.

In order to confirm my belief that the hardness and toughness of the gold used is a decided factor in retention of attachments, we made two further tests on the cemented three-quarter crown, cast this time with a really hard, tough metal, having a scleroscopic hardness of approximately 26 and a tensile strength of approximately 61,000 pounds per square inch. The cement used was the same as before, and the only changed factor was the increased tensile strength and hardness of the alloy.

In this case, it required an average stress of 61.5 pounds to dislodge the attachment. In the case of the slice preparation, the brass mold was so deformed by the stress necessary to dislodge the inlay that an accurate reading was impossible. While no claim is made that the same number of pounds pressure would apply in practical cases in the mouth, the relative stability of various forms of attachments should conform to these tests.

Also, while this research is purely preliminary, and should and will be followed by an extended series of similar tests, I believe it is fair to state that:

1. Neither the three-quarter crown nor the mesioclusodistal inlay constitutes a form of fixed bridge attachment greatly, if at all, superior to a properly made box-type proximoclusal inlay, as far as displacement under stress is concerned.

2. The full cast crown resists displacement in the ratio of nearly twice that of either of the three forms mentioned.

3. A substantial increase in hardness and tensile strength of metal used causes a marked increase in resistance to displacement under stress in the case of the three-quarter attachment.

4. A mechanically locked form of attachment offers nearly twice the resistance to displacement exhibited by the full crown, and about three times that of the mesioclusal-mesioclusodistal or three-quarter crown.

CONCLUSION

A modern conception of proper attachments for fixed bridges on vital teeth should seriously consider not only form, function and esthetics, but also, and even more seriously, conservation of tooth structure in order that the complete health of the pulp may be certainly maintained, and, at the same time, adequate retention, that the continued confidence of the patient in fixed bridgework may be assured.

508 Essex Building.

3. Knapp, K. W.: Pop. Health Dent. Sup., February, 1926.

PHYSICAL CHEMISTRY OF DENTAL CEMENTS*

By WALTER S. CROWELL, B.S., Philadelphia, Pennsylvania

THERE is no material used by the dentist in his everyday practice which involves more applied chemistry than dental cement. The invention and manufacture of these compounds require detailed knowledge of reaction velocities, heterogeneous equilibriums and colloidal behavior, all in the field of concentrated solutions, where generalizations are few and unexpected variables many. The intelligent use of cements would appear to require an appreciation of the chemical phenomena involved.

All dental cements are prepared for use by adding a basic powder to an acid liquid until a putty-like mass is produced. In a short time, this mass hardens or sets, owing to the chemical reaction between the powder and the liquid. The great majority of cements in use today employ phosphoric acid solutions as the liquid. The character of the hardened cement depends fundamentally on the powder; while the working qualities are influenced to a large extent by the liquid.

Reactions between solids and liquids are known as heterogeneous reactions. They have frequently been investigated, and an equation describing them, the Noyes Whitney equation, has been deduced.

$$\frac{dx}{dt} = \frac{DS}{\delta} (A\text{-}X)$$

$\frac{dx}{dt}$ reaction velocity
D diffusion constant
S surface of solid
δ diffusion distance
A initial concentration of acid
X acid consumed in time t

This equation expresses mathematically the observations of our senses in reactions of this sort, such as the solution of metals in acid or sugar in water. For instance, we know that strong acid solutions act more energetically than weak solutions; that is, the reaction is accelerated by increasing A-X. As the acid is used up, its action becomes slower as A-X is decreased. If we want a substance to dissolve rapidly, we crush it into a fine powder. A thin sheet of metal dissolves more rapidly than the same metal in the form of shot. The fine powder and the thin sheet are examples in which the surface is large; while the shot presents a small surface to attack. If we throw some sugar into a cup of water and let it stand, it dissolves slowly, unless diffusion is added by mechanical agitation, reducing the distance δ.

This equation, based as it is on common sense, is the fundamental equation

*Read before the Section on Physics, Chemistry and Metallurgy, at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

governing the manufacture and use of dental cements. Its specific applications will be described more fully below.

Depending on the composition of the powder, we have the following types of dental cements: copper phosphate cements, zinc phosphate cements, silicate cements.

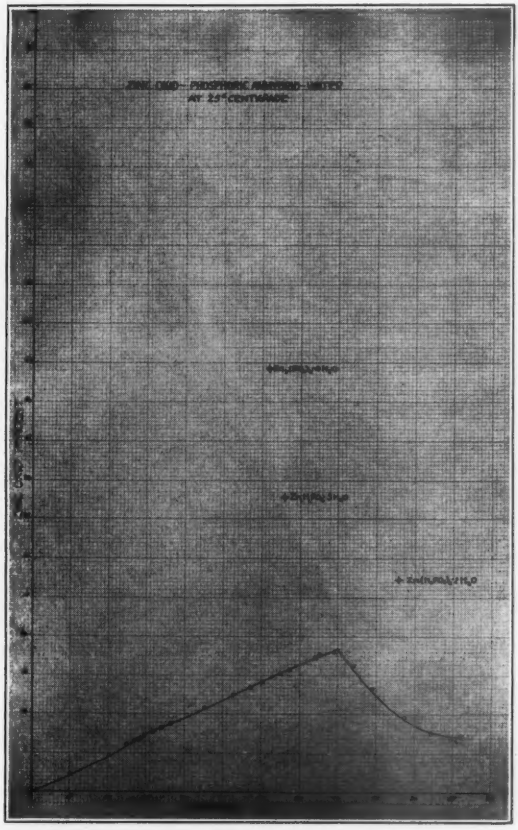

Fig. 1.—ZnO—P_2O_5. H_2O. Equilibrium at 25C.

Owing to their color, copper phosphate cements are seldom used unless the germicidal action of the copper is required. Zinc phosphate cements include those used for attaching crowns, bridges and inlays. Silicate cements are used chiefly for fillings, although recently a silicate crown and bridge cement has appeared on the market.

Zinc phosphate cements are the oldest and simplest type of phosphate cements. Their chemistry has been more completely studied than that of the other types.

The equilibrium between ZnO. P_2O_5. H_2O was studied by my associates and me some years ago.[1] The equilibrium diagram is shown below.

The work was carried out by conventional methods. We found that the solubility curve of ZnO in phosphoric acid at 25 degrees has three branches. The first branch represents the solubility of $Zn_3 (PO_4)_2 4H_2O$ in phosphoric acid.

It ends at 15.2% P_2O_5 and 7.5% ZnO. The second branch shows the solubility of $ZnH (PO_4) 3H_2O$ in phosphoric acid. It ends at 40% P_2O_5, 18.8% ZnO. The remaining branch of the curve indicates the solubility of $Zn (H_2PO_4)_2 2 H_2O$.

Fig. 2.—$Zn_3 (PO_4)_2$. 4 H_2O. (×20.)

The usual zinc cement liquid contains less than 50 per cent phosphoric acid. By inspecting the equilibrium diagram, we see that the two solid phases that can be present in the set cement are $ZnH PO_4 3AH_2O$ and $Zn_3 (P O_4)_2 4H_2O$.

You will note that the break between the $Zn_3 (PO_4)_2 4H_2O$ branch and the

1. Eberly, Gross and Crowell, W. S.: J. Am. Chem. Soc., 42: 1434 (June) 1920.

$Zn_2HPO_4\ 3H_2O$ branch of the diagram is not sharp. In carrying out our experiments, we had difficulty in preventing the separation and persistence of Zn H $PO_4 3H_2O$ in equilibrium mixtures below the quadruple point. This led us to believe that the crystalline phase in the set cement was wholly or largely ZnH $PO_4\ 3H_2O$. This was confirmed by the following experiment.

Mixes were made of commercial and experimental cements whose liquids contained various percentages of P_2O_5 and H_2O. These mixes were powdered and placed in dessicators over H_2SO_4 solutions of several concentrations, the powdered cements being thus exposed to atmospheres of various degrees of saturation with water vapor. When the samples reached constant weight, they were analyzed for P_2O_5 and H_2O. It was found that regardless of the original amount of water present in the mix, the powdered samples, when in equilibrium with air between 95 and 75 per cent saturated with water vapor (23 to 19 mm. vapor pressure 25 degrees) contained seven molecules of H_2O to one molecule of P_2O_5. $2\ ZnHPO_4 . 3H_2O = 2\ ZnO . P_2O_5 . 7H_2O$.

Fig. 3.—$Zn_3(PO_4)_2 . 4H_2O$. (×20.)

When we know the reaction and the end products resulting from the combination of cement liquid and cement powder, we can definitely determine the limiting chemical properties of the cement. The solubility, for instance, is dependent on the solubility of zinc acid phosphate. We know that this is rela-

tively insoluble in water. The only change which can occur after long service in the mouth is its conversion into $Zn_3 (PO_4)_2 . 4H_2O$, a substance more insoluble than the original zinc acid phosphate.

tion of liquids even before setting is complete.

When commercial zinc oxid and concentrated phosphoric acid are mixed together, a reaction takes place instantly. Heat is evolved, the mass sets rapidly

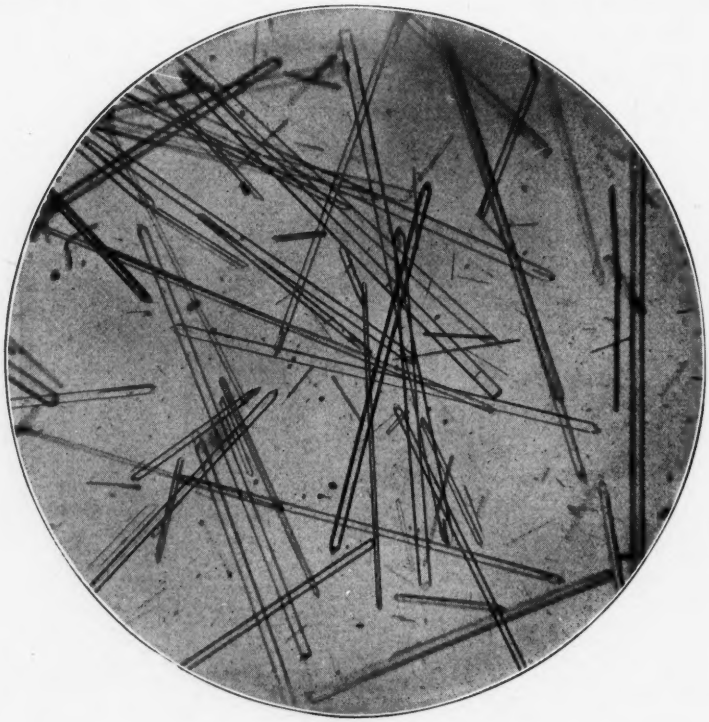

Fig. 4.—$ZnHPO_4 . 3H_2O$. (×20.)

Zinc acid phosphate, when mixed with its mother liquid, is a sticky, slimy mass; which accounts for the desirable plasticity of freshly mixed dental cement. $Zn HPO_4 3H_2O$ crystallizes from solution in spherical aggregates of branching crystallites, binding firmly together particles of powder and building up a mass extremely resistant to the penetra- and a porous, friable cement results. The problem in developing a satisfactory cement is to retard this reaction sufficiently so that time is given for proper manipulation before the mass hardens.

Inspection of the reaction velocity equation indicates the means that can be employed.

$$\frac{dx}{dt} = \frac{SD}{\delta} \quad \text{(A-X)}$$

We can vary (1) the surface of the powder; (2) the concentration of the acid in the liquid.

The zinc oxid of commerce is purposely prepared in a very finely divided form. Its value as a pigment or filler for rubber depends on its state of division. It is said to be "light" and "fluffy," which indicates that its apparent density is low. In order to decrease the surface, the fine particles must be caused to coalesce, making the powder "dense" or "heavy."

We can bring this coalescence about most readily by heat. The zinc oxid can be fused, and the resulting ingot crushed and ground. The high temperature required makes this process costly. If zinc oxid is mixed with other oxids and heated to between 1,000 and 1,400 C., depending on the kind and amount of other oxid used, it will not fuse, but will sinter together into a hard cake. When this cake is crushed and ground, its apparent density will be greatly increased and its activity, when it is mixed with acid, correspondingly reduced. Its fineness, and consequently its reaction rate when mixed with a given liquid, can be controlled.

Fig. 5.—$Zn(HPO_4)_2.2H_2O$ (natural size.)

It is not unlikely that an allotropic modification of zinc oxid is produced, although conclusive evidence of this fact has not been presented.

The activity of the liquid can be changed by varying the amount of free phosphoric acid in it, either by varying the amount of P_2O_5 in the solution or by partially neutralizing it. Both methods must be employed. If a large amount of water is present in the liquid, an excessive amount of free water will remain after the $ZnHPO_4$. 3 H_2O has crystallized, weakening the hardened cement. If the water is reduced to the proper value by increasing the P_2O_5, the acid will be too concentrated, and rapid setting will result. Partial neutralization must be resorted to. This may be looked on as a partial carrying out of the reaction between the powder and the liquid before the cement is placed in the hands of the user.

While any base can be used, it is obvious that only those forming insoluble phosphates should be employed. In most modern cements, zinc oxid and alumnia are the only bases added.

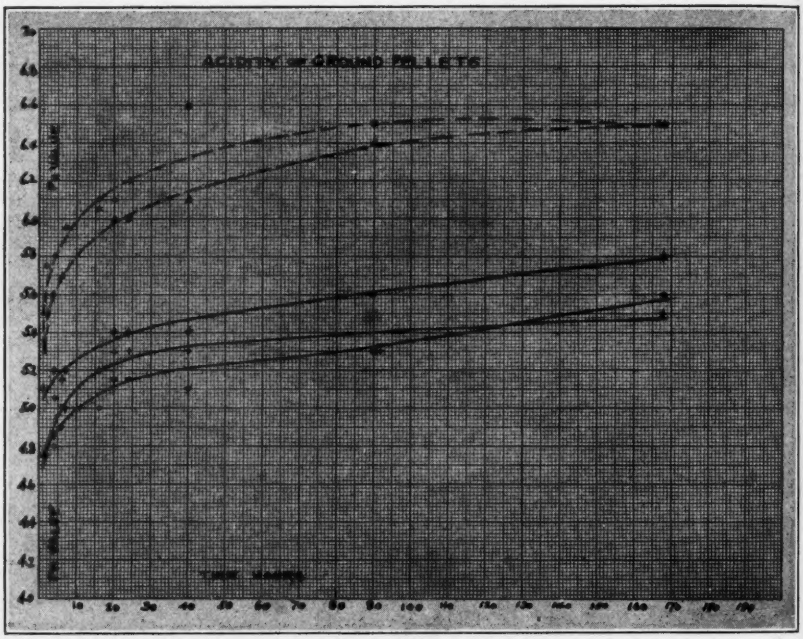

Fig. 6.—Graph to accompany Table 1.

For practical reasons, it is not advisable to make an excessively active powder and use it with an inactive liquid, or vice versa. By so doing, the mixing and working of the cement are complicated. It is much better to balance the two components and use a powder of medium activity with a liquid of the same character giving smoothness and ease of mixing.

When the powder and liquid are

turned over to the dentist, they represent an arrested chemical reaction, which the dentist proceeds to complete when he uses the cement. The manufacturer has designed his cement to give certain desirable properties when it is handled in what he believes to be an average manner, under average conditions of temperature and humidity.

The reaction rate is still, to some extent, in the hands of the dentist. By adding the powder rapidly in large portions, he exposes a large surface of powder to strong acid and makes rapid-setting cement. By adding the powder slowly, in small portions, with spatulation between, he progressively neutralizes the liquid, reduces the quantity A-X and produces a slow setting cement. A thick mix, since it contains more powder, exposing more surface to the liquid, sets more rapidly than a thin one.

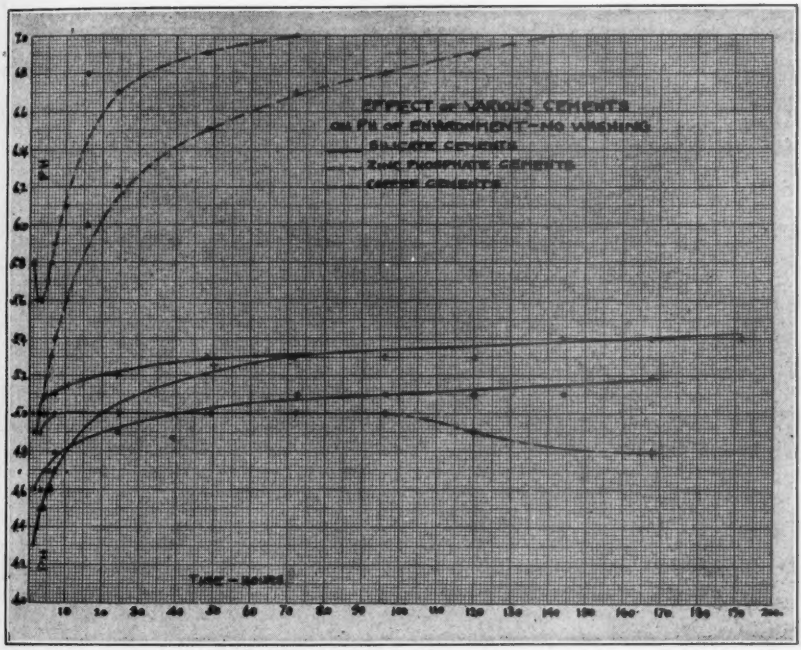

Fig. 7.—Graph to accompany Table 2.

It must be born in mind that the chemical reaction between the powder and liquid and the hardening of the cement are two separate though interdependent phenomena. The chemical reaction produces certain new compounds. These compounds first saturate the solution, then separate from it. Hardening depends not on the formation of the new compounds but on their deposition in a more or less continuous

phase. If their deposition is too much interfered with, by excessive spatulation, for instance, the formation of a continuous solid mass is prevented and a very weak and friable cement is produced.

powder and binding them together. If mixing is continued too long, the new compound will be deposited slowly, and before a fluid resistant mass is formed, saliva may come in contact with the cement, penetrate and destroy it. If

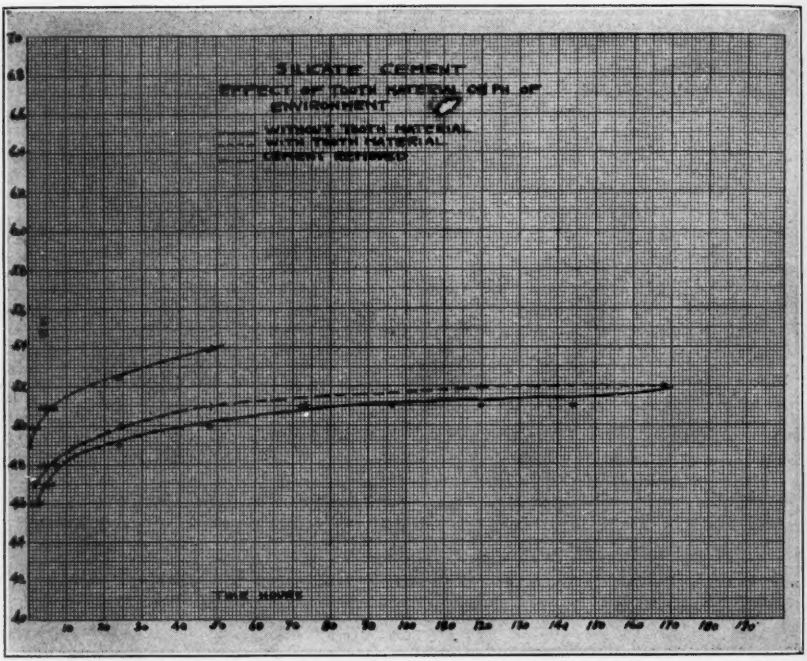

Fig. 8.—Graph to accompany Table 2.

Fundamentally, hardening begins when spatulation ceases. The hardening rate depends on the reaction velocity from that time on. It is thus evident that the workability of the cement depends on the mixing technic.

Mixing has an important effect on durability. As noted above, hardening depends on the deposition of a new compound in a continuous mass surrounding the undissolved particles of the cementing compound deposited is crystalline in nature, as it is in zinc oxid cements, no other damage is done, but if it is gelatinous or collodial as it is in silicate cements, durability is further impaired.

Good results cannot be obtained unless the powder and liquid are mixed together to a uniform mass. If in one portion there is some unmixed powder, a chalky noncohesive layer exists, which

at best is a plane of mechanical weakness, and, if it appears on the surface, forms a weak point for the attack of the cement by the fluids of the mouth. If there is some unmixed liquid in the powder, breaking up the continuity of the mass and rendering it weak and chalky. We must allow setting to continue until enough interlacing crystals of zinc phosphate are formed to pre-

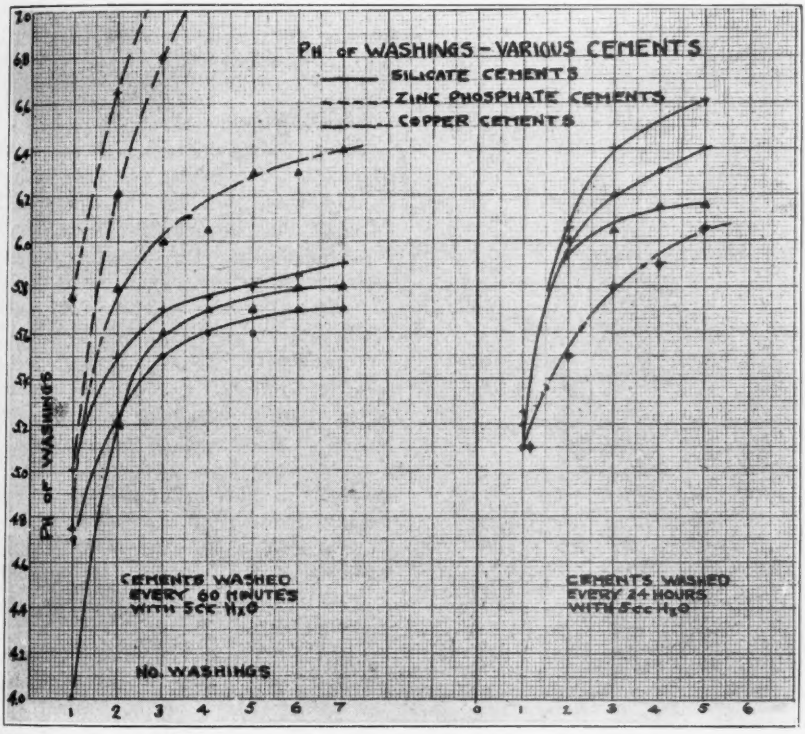
PH OF WASHINGS - VARIOUS CEMENTS
SILICATE CEMENTS
ZINC PHOSPHATE CEMENTS
COPPER CEMENTS
PH OF WASHINGS
CEMENTS WASHED EVERY 60 MINUTES WITH 5cc H2O
CEMENTS WASHED EVERY 24 HOURS WITH 5cc H2O
NO. WASHINGS

Fig. 9.—Graph to accompany Tables 3 and 4.

cement, this also forms a plane of weakness, if buried in the cement, or, if near the surface, will be dissolved in the saliva.

The cement must be kept dry until it is set. Insufficiently set cement is destroyed by washing out the free liquid from around the crystals of zinc phosphate and the undissolved particles of vent the saliva from getting in and the liquid from getting out.

We have shown that the setting velocity of a cement depends on the composition of the liquid. If this is changed, the setting velocity will be affected. When cement liquid is exposed to the air, as by leaving the bottle uncorked, water evaporates and finally

crystals are deposited. Liquid so treated is no longer of the composition carefully adjusted by the manufacturer to give the predetermined results with the powder. It is usually much slower in setting. In order to secure the best results, the liquid should be carefully stored and kept tightly stoppered, to prevent evaporation.

TABLE 1.—ACIDITY OF GROUND PELLETS—VARIOUS CEMENTS

	Silicate No. 1	Silicate No. 2	Silicate No. 3	Zinc Cement No. 1	Zinc Cement No. 2.
Time Hr.					
¼	4.40				
½	4.40	5.00		5.30	
1	4.75	5.10	4.70	5.50	5.30
2	4.80	5.10	4.75	5.75	5.50
4	4.80	5.20	5.05	5.80	5.60
6	4.90	5.15	5.00		
7	5.00	5.20	5.00	5.95	5.70
16	5.00	5.20	5.20	6.10	6.05
20	5.15	5.40	5.30	6.10	6.00
24	5.15	5.40	5.30	6.20	6.00
40	5.10	5.40	5.30	6.60	6.10
90	5.30	5.60	5.30	6.50	6.40
168	5.60	5.80	5.50	6.50	6.50

Silicate cements differ from zinc phosphate cements chiefly in the composition of the powder. The liquids are solutions of phosphoric acid partially neutralized with zinc oxid and alumina, differing from zinc cement liquids only in the amount of water contained.

The powders are complex acid-soluble glasses. Their constitution is unknown. When acted on by acids, silicic acid is liberated, but the base to which it was attached in the glass is difficult to determine. In our opinion, it is alumina. When a large amount of alumina is present, the powder is quick setting. Reducing the quantity retards the set.

The powders are made by melting together silica, alumina and fluxes, and heating until fusion is complete. A high temperature, about 1,400 C, is required. The resulting glass is crushed and ground to a fine powder.

Several compounds have been used as fluxes. The earlier cements, made in Germany, used beryllium silicate. Most of the cements manufactured in the United States use calcium fluorid. Calcium silicate, calcium borate and soda-lime glass have also been used, but the resulting cements have been deficient in translucence. In order to secure satisfactory translucence, the refractive index of the powder must be kept close to that of silicic acid, so that light will pass through both powder and surrounding medium with equal ease. The refractive index of the powder must be kept low, which requires the use of elements of low atomic weight, such as beryllium, boron and fluorin, in its composition.

Some of the earlier silicate cement powders were made by precipitation, but the uncertainty of this method has led to its abandonment in favor of fusion.

The problem with silicate cements is to prepare a powder and a liquid which will set rapidly enough for practical use. The activity of the powder is controlled to some extent by the amount of alumina in it. Unfortunately, highly aluminous powders are deficient in translucence. The other available control is fine grinding. The activity of the liquid is adjusted by the same

means employed with zinc phosphate cements.

It is generally understood that silicate cements require more careful manipulation than zinc cements. This belief is well founded, yet it frequently appears that the hastily made filling outlasts the one on which every care was lavished. The carefully made filling is frequently overworked, and the hardening process is disturbed.

Successful silicate technic is built around four simple rules: 1. Mix the powder and liquid together rapidly. 2. Be sure the mix is of the proper consistence throughout. 3. Insert promptly. 4. Allow to harden undisturbed.

Mixing rapidly, to the proper consistence, is important. Silicate cements set by the gelation of silicic acid. This occurs quite rapidly when the concentration of the acid in the liquid is sufficiently reduced. In order to have sufficient working time, a relatively slow setting liquid must be provided. If anything is done which would tend to slow up the reaction, setting will be unduly prolonged and, unless the filling is carefully protected, it will be damaged by the saliva.

Insertion should be prompt and the filling should be allowed to harden undisturbed. Silicic acid gel once broken does not grow together again. In the case of zinc cement, the breaking up of

TABLE 2.—p_H OF ENVIRONMENT—VARIOUS CEMENTS

	Silicate No. 1	Silicate No. 1 + Tooth Material	Silicate No. 2	Silicate No. 3	Copper Cement	Zinc Cement No. 1	Zinc Cement No. 2	Cement Extract + Tooth Material
Time Hr.								
0								4.90
1	4.6	4.7	5.0	4.3	4.9	5.8	5.0	5.00
2	4.6	4.7	5.0	4.4	4.9	5.6	5.0	5.00
3	4.6	4.8	5.0	4.5	4.9	5.6	5.1	5.10
4	4.7	4.8	5.1	4.5	5.0	5.6	5.3	5.10
5	4.7	4.8	5.1	4.6	5.0	5.7	5.4	5.10
6	4.7		5.1	4.6	5.1	5.8	5.5	5.10
7	4.8		5.1	4.7	5.0	5.9		5.10
10						6.1		
16						6.8		
Days								
1	4.9	5.0	5.2	5.0	5.0	6.7	6.0	5.25
2	5.0	5.1	5.2	5.3	5.0	6.9		5.40
3	5.1	5.1	5.3	5.3	5.0	7.0	6.2	
4	5.1	5.2	5.3	5.3	5.0	7.1	6.6	
5	5.1		5.3	5.3	4.9		6.6	
6	5.1		5.4	5.4				
7	5.2		5.4	5.4	4.8			

the crystal aggregates did not permanently destroy the continuity of the mass. The fragments formed nuclei for new aggregates. The fragments of silicic acid do not grow. They may be cemented together by the deposition of additional gel, but the continuity of the mass is permanently impaired. Silicate cement should not be worked after hardening begins. No time should be lost in inserting and applying the strip. The strip or matrix should be left in place until considerable mechanical strength is developed and there is no longer danger of rupture. Finishing should be delayed until the following day.

Most of the good and bad properties of silicate cement are due to silicic acid. Silicic acid is an irreversible colloid. If water is withdrawn from the surface of the cement during setting, the silicic acid is dehydrated and a chalky layer is formed. While rehydration occurs to a small extent, the strength and translucency of the surface layer is seriously impaired. It is therefore poor practice to dehydrate the cavity drastically before inserting a filling, since the dessicated dentin will withdraw liquid from the soft cement. It is necessary to prevent dehydration of the surface by evaporation during finishing by the liberal use of cocoa butter. Anterior fillings are seldom successful in patients who are mouth breathers.

Translucence is a striking and valuable property of silicates. It is not fully developed immediately on mixing. Time is required for the reaction to be completed and the mass to become uniform in composition throughout. Most of the change is complete in twenty-four hours. Translucence makes the cement inconspicuous in the mouth. If we could duplicate the optical structure and properties and color of the tooth enamel in a plastic, we should have a perfectly inconspicuous filling. Translucence can be closely matched, but structure is, at present, beyond us. Color duplication is largely in the hands of the user. The manufacturer furnishes pigmented powders which must

TABLE 3.—p_H WASHINGS—VARIOUS CEMENTS—60 MINUTE INTERVALS

	Silicate No. 1	Silicate No. 2	Silicate No. 3	Copper Cement	Zinc Cement No. 1	Zinc Cement No. 2
No. Washings						
1	4.7	5.00	3.95	4.75	5.75	5.00
2	5.2	5.50	5.20	5.80	6.65	6.20
3	5.5	5.70	5.60	6.00	7.25	6.80
4	5.6	5.75	5.70	6.05	7.50	7.15
5	5.6	5.80	5.70	6.30		7.20
6	5.7	5.85	5.80	6.30		7.25
7	5.7	5.90	5.80	6.40		

be combined by the dentist for the case at hand. With proper translucence, the filling will be inconspicuous, even if the color match is not perfect. If the passage from one material to another is not accompanied by wide variations in translucency, small differences in color are not noted by the eye.

Translucency calls for two precautions in the use of silicate cements. Small amounts of colored material produce a marked effect on the color of the cement. Thus, the darkest gray after a few days. The dentist should not use the fresh mix of cement on the slab as a guide to matching. He should use the shade guides provided by the manufacturer or use a shade which will be apparently light when freshly inserted.

Since the earliest use of dental cements, the irritation of the dental pulp by the acid of the cement liquid has been regarded as a dangerous possibility. The dental literature of thirty years ago contains frequent references

TABLE 4.—P_H WASHINGS—VARIOUS CEMENTS—24 HOUR INTERVALS

	Silicate No. 1	Silicate No. 2	Silicate No. 3	Copper Cement	Zinc Cement No. 1	Zinc Cement No. 2
No. Washings						
1	5.1	5.25	5.20	5.10	6.80	6.40
2	6.0	6.05	5.95	5.50	7.20	7.00
3	6.2	6.40	6.05	5.80	7.50	7.20
4	6.3	6.50	6.15	5.90	7.35	7.05
5	6.4	6.60	6.15	6.05	7.35	7.40

owes its shade to about one part of pigment to 5,000 parts of colorless base. It is apparent that a very small amount of dirt worked into a mix of cement will very positively effect its shade. The color produced in a cement by a given quantity of pigment depends on the translucency of the cement. As translucency increases, color deepens. Therefore, a fresh mix of cement is much lighter in color than a filling of the same shade which has set for some time in the mouth. A filling which was a perfect match when first inserted may be dark enough to be conspicuous

to pulp irritation and pulp death following the use of zinc phosphate cements. Because of the widespread use of silicate cements in the past fifteen years, zinc phosphate cements have ceased to be suspected. In fact, they are now looked on as being free from this danger. Silicate cements are generally considered more acid, and, hence, more dangerous, than the zinc phosphates, and all published silicate technics contain steps intended to guard against the passage of acid from the cement to the pulp. In cavities involving the dentin, varnish is recommended;

while, in deep cavities, the dentist is advised to cover the floor with zinc phosphate cement. Both of these measures tend to prevent the escape of acid from the cement into the tooth.

Experience has shown that sterilization with phenol, thymol or ammoniacal silver nitrate (Howe's solution) is good practice, and there are numerous reports that, when this procedure is followed, there is little danger of subsequent trouble.

Copper cements are recommended and apparently used with impunity in all sorts of cavities, deep and shallow.

In brief, it is generally believed that silicate cements will cause pulp irritation unless precautions are taken to prevent it. Zinc phosphate cements, formerly suspected of causing pulp irritation, are now used without thought of this danger; in fact, they are recommended as a means of preventing it. Copper cements have never been suspected of causing pulp irritation.

The convenience and beauty of silicate restorations make the subject of pulp irritation under them of great importance to the dentist. While the action of cement-reaction products on the pulp is not a chemical problem, the kind and nature of the compounds given up by the cement to its environment is. This phase of the matter has been investigated in our laboratory.

Dental literature shows that three conditions have been suspected as the cause of pulp irritation: the presence of (1) arsenic or of (2) hydrofluoric acid; or acidity. The presence of arsenic in any kind of cement is a remote possibility today. It can be readily detected in both raw materials and finished product, and it is not difficult to insure its absence.

Fluorin is present in most modern silicates, but in an insoluble form. The aqueous extract of mixed and set cement has been examined for this element by the very delicate colorimetric method of Steiger[2] and Merwin.[3] Eleven grams of mixed cement in the form of flat pieces about 20 mm. in diameter by 3 mm. in thickness was placed in 70 c.c. of distilled water ten minutes after mixing, and soaked for two months. No action on the glass container was noted. Fifty cubic centimeters of the solution so obtained was tested for fluorin and was found to contain 0.007 per cent. Concentrated hydrofluoric acid, like most other strong acids, is intensely corrosive, but, in dilute solutions, it is not particularly toxic. Rather massive doses of alkaline fluorids are required to produce death. It does not seem probable that the small amount of fluorin dissolved from silicate cement will have any toxic action on the pulp.

The remaining irritant acid (probably phosphoric acid or acid phosphates) has been studied from three points of view: (1) the acidity of the cement mass itself after setting for various periods; (2) the acidity produced by the cement in its environment when conditions are so arranged that there is no circulation or washing action; that is, no passage of water or solution into

2. Steiger: J. Am. Chem. Soc., 30: 219, 1908.

3. Merwin: Am. J. Sc., Vol. 28: 119, 1909.

or away from the vessel containing the cement; (3) the acidity of the environment when washing does take place; that is, when the water or solution surrounding the cement is periodically changed.

The quantities of acid involved were found to be very small, but we were able to measure them by means of indicators.

Zinc, copper and silicate cements were all investigated so that comparisons could be made.

The acidity of the cement mass itself is not easily determined, particularly during the initial stages of setting. Several methods have been employed: 1. In spot tests, the mixes of the cement were made, spread out in thin layers and broken into small pieces. Drops of indicator solution were applied to these pieces from time to time and the color changes noted. The setting of the cement was so interfered with by evaporation that accurate results were not obtained. 2. The indicators were mixed with cement powders before combining with the liquid. This resulted in colored pellets, and the time at which color changes occurred were noted. The natural color of the cement interfered with the accurate observation of the color changes, and the results were little better than those obtained by the spot method. 3. Mixes were made and, after setting a short time in glass molds, were immersed in measured quantities of water and allowed to remain for definite periods. The pellets were ground with the water in which they had been kept; more water was added, and the mixture was filtered. The acidity of the filtrate was measured. Fairly definite and reproduceable results were obtained which were indicative of the total potential acidity of the cement. It was recognized that the preparation of the filtrate itself introduced errors, and, furthermore, the intrinsic acidity of the cement might have little to do with the acidity it produces in its environment.

It is evident that a cement in the mouth is bathed on one side by saliva, food, etc., and is continually exposed to fresh solution. On the other side, it is in contact with the tooth structure, an organ in which circulation is almost nonexistent. The cement tends to saturate with acid the fluid in the dentin with which it is in contact. The acid can probably be removed only by diffusion, with little or no assistance from the circulation. There is the possibility of neutralization of the acid by the mineral salts in the dentin, and, as setting proceeds, it is likely that the cement itself will bind some of the acid which escapes in the earlier stages.

The saliva is a buffered solution with an average p_H of 6.6.[4] It seems correct to assume that a cement is no longer dangerous to the pulp when the acidity of its saturated solution falls to this value. If the circulation in the dentin and pulp was rapid, it might be expected that the buffer action of the blood (p_H7.4) would be sufficient to take care of small quantities of acid given off by the cement filling.

The effect of the cement on its environment when no circulation is

4. Starr, D. E.: J. Biol. Chem. 54: 43 (Sept.) 1922.

allowed was tested as follows: Mixes were made and formed into disks about 1.5 mm. thick by 20 mm. in diameter. These disks were placed in test tubes containing 5 c.c. of water, and the acidity of the water was periodically observed by means of indicators. This gave a measure of the acidity produced by the cement. Similar tests were made with the exception that natural teeth were placed in the tubes with the cement. The observations then gave a measure of the combined effect of tooth material and cement. The effect of circulation or washing was readily measured by similar tests, in which water was changed periodically and the acidity of the wash water measured. The results obtained on silicate cements, zinc oxyphosphate cements, and copper cements are shown on the accompanying tables of results and curves.

Acidity of ground pellets: Cement liquids contain 30 per cent or more free phosphoric acid. In fifteen minutes after mixing, the acidity is reduced to 1 part in 30,000, or less. The reduction is greatest and most rapid in zinc phosphate cement. Silicates neutralize more slowly. The pellet acidity falls rapidly at first, then more slowly. Zinc phosphate cements reach an acidity corresponding to p_H 6.5 in about seven days. Silicate cements never reach this value, becoming constant at between p_H 5.5 and p_H 5.8.

Effect of cement on the acidity of its environment: The difference between zinc phosphate cements and copper and silicate cements is more pronounced in this test. Zinc phosphate cements are self-neutralizing. The acidity of the environment falls steadily until neutrality is reached, in from three and six days. Silicate cements never become neutral. Their initial acidity is higher than that of the zinc cements and the environment is never made more nearly neutral than p_H 5.2 to 5.4, corresponding to between one two-hundred-thousandth and one three-hundred-thousandth.

It is interesting to note that copper cement is no more acid than the silicates to start with, but after going up to p_H 5.0 and remaining there for several days, it begins to become more acid, falling to p_H 4.8.

When natural teeth were placed in the tubes with silicate cement, a slight neutralizing effect was noted at first, but the reaction of the liquid became constant at p_H 5.2, corresponding to the reaction of controls run at the same time without the addition of natural teeth.

Some "extract" was prepared by soaking pellets of cement in water overnight and removing the cement the next morning. This solution was acid enough to attack tooth material, as shown by the steady rise in p_H when a tooth was soaked in it.

Zinc phosphate cements could be readily washed free of acid. Two or three 5 c.c. portions of distilled water were sufficient.

Copper cement did not respond so quickly. It seemed to be more soluble in water than the other cements, and the reaction (p_H) of the wash water was markedly affected by the period during which it was in contact with the cement. With rapid washing, 5 c.c.

per hour, p_H of 6.4 was reached after seven washings. When the washing was at the rate of 5 c.c. per twenty-four hours, the reduction in acidity was much slower.

Silicate cements responded most slowly of all. After seven washings, the change in reaction was very slow, and p_H 6.5 was reached only with difficulty. There was a strong tendency for the washings to remain at p_H 6.0. Apparently, small quantities of acid can be leached out indefinitely.

The general conclusions we can draw from the foregoing are: 1. Under all conditions, zinc cements are less acid than either copper cement or silicate cement. 2. Copper cements and silicate cements are closely similar in acidity. 3. The acidity of even the most acid cement is small, no cement producing a permanent acidity in its environment greatly in excess of 1 part in 100,000.

The acidities observed with silicate and copper cements are higher than the highest acidity of saliva reported by Starr. The most acid observed by him was p_H 5.75. Bunzell reports two observations at p_H 5.35.

The lack of pulp irritation under zinc phosphate cements can be explained by their low acidity, but this explanation is not applicable to copper cement. On the basis of acidity, copper cement should be quite as likely to cause pulp trouble as silicates. This does not appear to be the case. Besides, the numerous reports of pulp irritation under zinc cement fillings in the dental literature cannot be altogether without foundation. While chemical engineers hesitate to speculate about biologic phenomena, it appears to us that there is enough evidence at hand, clinical and laboratory, to cast serious doubts on the acid theory of pulp irritation under silicate fillings and to indicate that there is another explanation of this phenomena.

Copper cement is as acid as silicate cement, yet pulp irritation does not follow its use. Copper cement is a germicide. A. Hopewell-Smith[5] has shown[3] that any cavity involving the dentin carries with it the possibility of deep bacterial invasion, involving the pulp. If cavity sterilization is carefully carried out, or if a germicidal filling material such as copper cement is used, no pulp disease will follow the operation. On the other hand, if the cavity is not sterilized and a nongermicidal filling material such as silicate cement is inserted, the infection remaining will probably cause pulp irritation and, if the resistance of the patient is low, pulp death.

The foregoing considerations and the success of silicate operators who practice sterilization lead us to believe that the acidity of silicate cements is not the determining factor in the pulp disease which at times follows their insertion. In our opinion, infection is more important. Attention should be focused on infection rather than on the prevention of the passage of acid from the cement to the tooth.

There is another cause of pulp irritation and death under silicate cements which should be mentioned. It occurs

5. Hopewell-Smith, A.: Dent. Items Int., 47: 477, 1925.

particularly in deep, large cavities. The cavity is filled to excess and the strip drawn firmly across it, crowding the cement into the tooth, and creating pressure on the thin wall of dentin overlying the pulp. This pressure may cause some deflection of the dentin, resulting in pressure on the pulp and subsequent trauma and death. This source of trouble can be easily overcome by strengthening the floor of the cavity with a zinc oxyphosphate cement lining.

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DISCUSSION

John A. Marshall, San Francisco, Calif: Although the title of Mr. Crowell's paper would lead one to infer that the contents are exclusively physical chemistry, he has woven into the discussion a good summary of the "mixing" technic. Since dentistry is primarily a technical profession, any remarks on the subject are particularly apropos and interesting. This paper appears to be devoted largely to the application of certain physical-chemical laws to the mixing of cement. The comparisons of the solubilities of the different types of cement emphasize at least two facts: (1) that our dental cements are too soluble for permanency and (2) that the manner of mixing the cement greatly influences this property. I am not sure that Mr. Crowell has given sufficient importance to the problem of infection in dentin tubules. It used to be thought, and probably there is still some reason for holding this view, that the phosphoric acids in the cement brought about pulp death. In a well-balanced mix in which liquid is well incorporated with powder, this does not seem to be possible, and then again there is always the question of the personal equation. Of equal significance is the possibility that the cement powder may contain certain impurities which exert an effect on the pulp similar to that of arsenic. Of more importance is the matter of infection. Too frequently in our operating, we overlook this feature. In our zeal to avoid exposure of the pulp, we are prone to neglect to sterilize the cavity walls. This is the chain of events which usually follows: A pulp, already hyperemic from infection, is further traumatized with a liquid or solid which is not of the same p_H value as blood serum. Fortunately, the pulp possesses recuperative power, and, in most cases, builds secondary dentin as a protection. Sometimes the degree of irritation is too acute or too prolonged, and, as a consequence, pulp death ensues. We are not justified in blaming the cement for the pulp death, but should we rather blame ourselves for neglecting to sterilize the cavity or at least judiciously to apply sterilizing fluids before inserting the filling. If the dental manufacturers could build a cement which is not porous, the problem of pulp infection would not be so serious nor so difficult to meet.

ANTISEPSIS IN HYGIENE OF THE TEETH AND GUMS*

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FUNDAMENTAL RATIONALE OF MOUTH HYGIENE

THE general impression that the teeth and gums are more frequently the seat of pathologic change (dental caries, pyorrhea, etc.) than any other body tissue is probably quite accurate. This cannot be said of the offhand explanation of this observation so frequently advanced, namely, that the soft, creamy foods characterizing the modern diet are largely responsible for the unsatisfactory condition of the teeth. Not only is experimental evidence in support of this theory peculiarly difficult to find, but as far as dental caries is concerned, recent observations by Schultz[1] on the evolution of human teeth would appear to rule out the dietary conditions of civilization as a cause since dental caries is found to be common among certain species of monkeys in their natural environment.[2] Schultz finds that, both in man and in these monkeys, there is now in progress an evolutionary process characterized by a disproportionate reduction in the size of the jaw as compared with the tooth row, with consequent crowding of the teeth, an observation that is supported by all of the anatomic evidence furnished by fossil remains and by comparison of primitive with higher human types.

While it may be argued that dietary change may be a contributing factor in the progress of this evolutionary process, the crowding of the teeth, which is its direct consequence, certainly offers additional opportunity for the accumulation of bacterial masses and food débris in the many inaccessible crevices and inequalities of surface that result. Admitting that other than local factors, such as various systemic diseases, mercurialism, and both physiologic and pathologic alterations in metabolism, may, in certain instances, contribute to the frequency of pathologic conditions of the teeth and gums, the almost universal occurrence of such conditions as dental caries in otherwise apparently normal individuals clearly indicates the existence of an essential factor that is purely local.

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†The participation of Dr. Percy D. Meader, associate professor of bacteriology in the Johns Hopkins School of Hygiene and Public Health, with whom this work was planned, was prevented by his untimely death in December, 1926. The authors have attempted to follow as closely as possible the lines of investigation originally selected.

1. Schultz, A. H.: Dent. Cosmos, 67, 935 (Oct.), 1053 (Nov.) 1925.

2. Dental caries is common in old age in both wild and domestic animals.

Not only are the teeth and gums more frequently the seat of pathologic change than is any other body tissue, but, even in mouths well cared for, they may harbor greater numbers of micro-organisms than does any other tissue surface. In sharp contrast with scrapings from other parts of the mouth, material from the gum margins, for instance, contains even greater numbers of viable bacteria than many times this bulk of fresh human stools,[3] in addition to large numbers of micro-organisms that cannot be cultivated by present methods. The weight of evidence clearly indicates that these two observations bear more than a coincidental relationship to one another, and that could some means be devised by which this massive sepsis could be largely reduced and held in check, a long step might be taken toward the control of such prevalent conditions as dental caries and pyorrhea.

To accomplish this end, there would appear to be but two basic methods offering any chance of success: (1) the dislodgment of bacteria and food débris from the teeth and gums by mechanical means; (2) disinfection of this septic material *in situ*.

The mouth is, of necessity, being constantly reinfected. It is obvious, therefore, that any method of reducing the sepsis invariably present in the normal mouth must be one which is very simple and can be repeated daily or oftener by the average individual without injury, and preferably without discomfort, added expense or loss of time. Otherwise, the usefulness of such a method would be greatly restricted and its value as a public health measure largely destroyed. The habitual use of tooth paste by the American public, while probably unique among the large populations of the world, instantly suggests itself as the logical basis of such a method. Furthermore, the removal of food débris from the teeth and gums, which should certainly accompany any attempt at disinfection of these surfaces, is accomplished more effectively by a preparation containing an abrasive than by a liquid dentifrice or mouth wash. Although there are well founded objections to the presence of insoluble material in a dentifrice, the advantages appear to outweigh them, and should it be found possible to accomplish the disinfection sought, only through the use of an antiseptic liquid, tooth paste could still not be discarded. The two preparations would have to be used in combination, which would probably restrict the usefulness of the method.

Granting that the regular use of a tooth paste containing a relatively harmless abrasive, such as chalk, may be depended on to remove the bulk of the food débris from the teeth and gums, the problem is narrowed to a consideration of ways and means of dealing with the septic condition that is continuously present. A solution of this problem demands experimental investigation of the following questions:

A. Can this septic condition of the teeth and gums be satisfactorily reduced by mechanical means, such as thorough scrubbing with a tooth paste consisting essentially of soap and chalk?

B. Can this septic condition of the teeth and gums be satisfactorily reduced by any of the tooth pastes now in general use, especially those containing antiseptic ingredients?

3. Data to be published.

C. What qualifications should an oral antiseptic possess, and are any of the antiseptics or germicides now available, suited to this purpose?

FAILURE OF MECHANICAL FACTORS AND OF THE TOOTH PASTES NOW IN GENERAL USE

A complete investigation of the first two questions has already been reported in detail.[4] The results may be summarized as follows:

1. The bulk of the enormous numbers of bacteria present in every normal mouth are found to be clinging tenaciously to the surfaces of the teeth and gums. In the normal mouth, therefore, oral hygiene is essentially a problem of hygiene of the dental zone.

2. If the mouth is rinsed with 1,000 c.c. of water divided into 40 separate rinses of 25 c.c. each, and each mouthful swished about in the mouth and forced between the teeth, there may be just as many bacteria found in the fortieth rinse as were present in the first. This experiment was repeated six times by each of four individuals, with the same result. Therefore, it is concluded that no dependable reduction in the number of bacteria in mouth washings occurs immediately after thorough and vigorous rinsing with large quantities of water.

3. If the teeth and gums are scrubbed vigorously with a new toothbrush of "medium" stiffness for a period of three minutes[5] (the brush being frequently washed under the running tap[6]), the number of bacteria found in 25 c.c. mouth rinses obtained ten minutes after scrubbing may be as great as or greater than the number found in the control rinse, obtained before scrubbing. This experiment was repeated three times by each of four individuals, with the same result. Therefore, it is concluded that no dependable reduction in the number of bacteria in mouth washings occurs immediately after thorough and vigorous scrubbing of the teeth and gums with brush and water.

4. If the teeth and gums are scrubbed vigorously with a new toothbrush of "medium" stiffness for a period of three minutes, the bristles being entirely covered with a soap-chalk tooth paste, the number of bacteria found in 25 c.c. mouth rinses, obtained ten minutes after scrubbing, may be as great as or greater than the number found in the control rinse, obtained before scrubbing. This experiment was repeated four times by each of four individuals, with the same result. One individual then repeated this procedure three times at thirty-minute intervals, yet the average number of bacteria in mouth rinses obtained ten, thirty, sixty, ninety and 120 minutes after the third scrubbing was greater than the number counted in the 25 c.c. control rinse, obtained just before the first scrubbing. Therefore, it is concluded that no dependable reduction in the number of bacteria in mouth washings occurs immediately after thorough

4. Leonard, Veader, and Feirer, W. A.: Dent. Cosmos, to be published.

5. Observation of the habits of a number of individuals indicate that only thirty seconds is ordinarily consumed in brushing the teeth; forty-five seconds is unusual; one minute is rare.

6. Frequent checks on the tap water in the laboratory showed it to contain from four to six organisms per cubic centimeter. Since this number is negligible, tap water was employed in these and all subsequent experiments in the mouth.

and vigorous scrubbing of the teeth and gums with a simple soap-chalk tooth paste.

These experiments indicate strongly that the various mechanical factors ordinarily involved in brushing the teeth, namely, the rinsing with water, the friction of the toothbrush bristles, the scouring action of the abrasive and the cleansing action of soap, even when combined, are entirely incapable of satisfactorily reducing the massive infection continuously present about the teeth and gums. They indicate, further, that any reduction observed after the use of a tooth paste containing an antiseptic, is referable to the activity of that antiseptic rather than to any of the mechanical factors involved.

Question A may therefore be considered to have been answered in the negative.

Investigation of Question B. Can this septic condition of the teeth and gums be satisfactorily reduced by any of the tooth pastes now in general use, especially those containing antiseptics?

Of the forty-one brands of tooth paste purchased in the open market and examined for antiseptic[7] action in the test tube under conditions of dilution (4 parts of water) and temperature (37 C.) simulating those in the mouth, not a single preparation was found to be capable of destroying *Staphylococcus aureus* even after five minutes exposure

7. The Division of Drug Control of the Bureau of Chemistry, U. S. Department of Agriculture, has ruled that the use of the term "antiseptic" on a commercial label shall be confined to those preparations actually capable of destroying bacteria. To avoid confusion, the term "antiseptic" is employed exclusively in this paper in accordance with this interpretation.

According to information believed to be authoritative, a group of eight of these preparations account for about 90 per cent of the entire tooth paste consumption in this country. Therefore, an especially complete examination was made of this group, for the reason that the results might be expected to furnish information directly applicable to the greater part of our population.

1. None of these eight preparations were capable of destroying *Staphylococcus aureus* in the test tube under the conditions described above.

Observations were then made on the possible effect of these preparations in reducing the bacterial content of mouth washings. The teeth and gums were scrubbed vigorously for two minutes with a toothbrush of "medium" stiffness, the bristles being entirely covered with a layer of tooth paste as squeezed from the tube, and the bacterial content of 25 c.c. mouth rinses of water determined by actual count both before (control) and at intervals of ten, thirty and sixty minutes after scrubbing the teeth.

2. Repeated single applications of each of these eight tooth pastes in different individuals by this technic resulted, almost invariably, in an increase in the average bacterial content of mouth washings obtained during the first hour after scrubbing the teeth.

3. These eight tooth pastes were then employed for three consecutive days, the teeth and gums being scrubbed for two minutes after each meal by eight individuals, to each of whom a different preparation had been assigned. The average of all bacterial counts made during the first hour after scrubbing the teeth showed an increase over the corresponding control counts varying from 16 to 182 per cent.

Question B may therefore be considered to have been answered in the negative.

THE QUALIFICATIONS NECESSARY TO AN ORAL ANTISEPTIC AND REASONS FOR THE FAILURE OF VARIOUS GERMICIDES IN THIS FIELD

The problem of oral antisepsis does not differ in principle from that of disinfecting any tissue surface. It is not difficult, therefore, to enumerate the properties which any germicide should possess to be perfectly adapted to this use. It should be: (1) chemically stable; (2) nontoxic; (3) nonirritating; (4) rapidly bactericidal in high dilution; (5) highly penetrating, and (6) unaffected by organic matter.

It may be added that, for use in the mouth, such a substance should also be free from stain and objectionable taste.

Representatives of practically every type of antiseptic have been incorporated in tooth pastes. Among the forty-one preparations recently examined, the following antiseptic ingredients were found in addition to the essential oils employed as flavors:

Aromatic germicides including phenol and cresols.

Oxidizing agents, including potassium chlorate and calcium and strontium peroxids.

Compounds of heavy metals including mercury and zinc.

Weak acids, such as boric and benzoic acids and their salts.

Ethyl alcohol and formaldehyd.

Iodin was stated to be a constituent of one paste, but no free iodin could be found.

The importance of each of the six properties enumerated above as more or less essential to an effective oral antiseptic, their particular application in oral hygiene and their relation to the unsuitability or failure of various germicides in this field, may be summarized as follows:

1. *Stability.*—Even though a substance might possess each of the other five qualifications, loss of its bactericidal action, due to relatively rapid chemical disintegration, would destroy its usefulness. Many germicides may be ruled out on this account, such as most of the oxidizing agents and both organic and inorganic salts of silver. While many of these substances keep perfectly in the dry state, they become very unstable and undergo chemical change in solution or when incorporated in pastes.

2. *Toxicity.*—Oral hygiene necessarily involves the daily repetition of a given procedure, such as brushing the teeth, over long periods of time. For this reason, the possibility of a cumulative toxic effect from the daily absorption of even minute quantities of an essentially toxic ingredient of the preparation employed must be taken into consideration, to say nothing of the possibility of accidentally swallowing larger amounts. This danger alone should be sufficient to rule out absolutely the use of any derivatives of mercury or silver in preparations intended for daily use in the mouth, and the uncontrolled sale of such products to the public should be prohibited.

3. *Irritant Properties.*—Most germicides are decidedly irritant in bactericidal concentrations. This is particularly true of those in the aromatic series such as phenol, the cresols and benzoic acid, and we have found it to be true also of beta-naphthol and most of the essential oils commonly employed as flavors. While almost any highly flavored tooth paste will destroy exceedingly delicate organisms such as *Streptococcus hemolyticus*, the incorporation of a sufficient

quantity of essential oils or of these phenolic germicides, to insure active bactericidal properties, results in a preparation which is too irritating for use in the mouth.

4. *Dilution Velocity of Bactericidal Action.*—The dilution of a germicide necessary to avoid irritation is still further increased when the preparation containing it is applied in the mouth. For instance, most individuals apply tooth paste on a wet brush; further dilution occurs through admixture with saliva, and, usually, additional water is taken into the mouth while brushing the teeth. Even though bactericidal properties were demonstrable in the paste itself, this dilution might readily be sufficient to destroy them. The highest dilution that retains bactericidal activity should therefore be considerably greater than the lowest dilution that is non-irritating. Few germicides meet this qualification.

The average individual consumes hardly more than from thirty to to forty-five seconds in brushing the teeth. The mouth is then rinsed with water. If this observation is reasonably accurate, it is obvious that bactericidal action should take place very rapidly, else it would probably be lost.

5. *Penetrability.*—Aqueous solutions of germicidal substances vary widely in their ability to penetrate or "seep" into tiny crevices or interstices. All tissue surfaces are abundantly supplied with these microscopic irregularities in surface, and bacteria occupying their depths may remain entirely unharmed by germicidal solutions of low penetrability applied on such surfaces.

This property of penetrability on the part of aqueous solutions is found to be closely associated with the ability of the substance dissolved to lower the surface tension of water. In general, the lower the surface tension of the solution, the greater its ability to penetrate into tiny spaces. While most chemical substances lower the surface tension of water to some extent, alcohols and phenols are considerably more active as surface tension reducents than as inorganic germicides.

Soaps are among the more powerful surface tension reducents, and the efficiency of certain types of germicides is considerably increased by their presence. However, Frobisher[8] has shown that a small excess of soap may practically destroy their germicidal action.

Obviously, a germicide that itself depresses the surface tension of its solvents will be more efficient, other things being equal, than one that does not.

6. *Organic Matter.*—While no germicide is known that does not suffer some loss of bactericidal power in the presence of organic matter, certain germicides, such as those of the chloramin type, are excessively sensitive in this regard. Since quantities of organic matter are constantly present in the mouth, such as the constituents of saliva, mucus, desquamated epithelium and food débris, it seems that a fair degree of stability in the presence of this material is absolutely essential to any germicide intended for use as an oral antiseptic.

Freedom from stain and objectionable taste, while not essential, is very desirable in a germicide intended for use in

8. Frobisher, M.: J. Bacteriol., 13: 163, 1927.

the mouth. Were it not for their objectionable stain, a number of dyes might be useful in this field.

After ruling out germicides that are chemically unstable, those that are essentially toxic, those that are very sensitive to organic matter, those whose physical nature renders them unsuitable, such as the germicidal gases, those that are obviously too feeble in their action and those that stain, we find that the field of available germicides has been practically covered, with one important exception—the phenols.

Reviewing briefly the properties exhibited by the better known antiseptics of the aromatic series, we find that *phenol* itself is too toxic and irritating to be used in the mouth in effective concentration, an objection that applies with even greater force to its halogen derivatives, chlorphenol and tribrophenol. While less toxic and less irritating, the cresols and creosote (composed chiefly of guaiacols and creosols) are practically excluded from use in the mouth because of their nauseous taste. Salicylic and benzoic acids are far too irritating to the mucous membrane in effective concentrations, an objection which also applies to resorcinol. The other two dihydroxybenzols, pyrocatechin and hydrochinon, are too poisonous, while *pyrogallol* leaves dark stains.

Alphanaphthol and betanaphthol are both fairly powerful germicides. While both are quite irritating in effective concentrations, betanaphthol, the least toxic, might be employed as an oral antiseptic were it not for the fact that it has been known to cause retinal degeneration in man even after external use.[9] Little is known of the alpha-oxynaphthoic and beta-oxynaphthoic acids except that they are both poisonous.

The paraphenolsulphonates are much less toxic than the phenols but are practically devoid of germicidal properties. The sulphocarbolates of sodium and of zinc, while possessed of considerable astringent action and moderately strong bacteriostatic action are practically devoid of germicidal properties.

Of the essential oils, thymol and eucalyptol stand out as being the most suitable. Both of these substances are possessed of considerable bactericidal power, and while effective concentrations are somewhat irritating and highly flavored, they appear to be more suitable as oral antiseptics than any of the foregoing phenols. This probably accounts for their presence in a large number of tooth pastes. While it might be possible to devise a preparation for practical use containing these two substances in effective concentration, none of those examined were found to have more than very feeble germicide action in the test tube.[4]

The biologic properties of a series of alkyl and iso-alkyl derivatives of resorcinol have been recently described by one of us.[10] This type of higher phenol, originally synthesized by Johnson and Hodge,[11] and subsequently studied from a chemical standpoint by Johnson and Lane[12] and by Dohme, Cox and

9. Van de Hoeve: Arch. f. Ophth., 53: 74.

10. Leonard, Veader: J.A.M.A., 83: 2005 (Dec. 20) 1924.

11. Johnson, T. B., and Hodge, W. W.: J. Am. Chem. Soc., 35: 1020, 1913.

12. Johnson, T. B., and Lane, F. W.: J. Am. Chem. Soc., 43: 348, 1921.

Miller,[13] has been thoroughly investigated as to the bactericidal properties of its various members.[13] As a group, the alkyl resorcinols now known probably represent the most complete homologous series of phenols ever synthesized. They possess the following structure:

where R is an alkyl group. Increase in the weight of the alkyl group, as the series is ascended, results in an enormous increase in germicidal power. The most interesting feature is the fact that, coincident with this great increase in bactericidal activity, there is no increase in toxicity to animals. This fact at once suggested their use as internal antiseptics.

As measured by the U. S. Hygienic Laboratory method, the weakest member of this series was found to possess approximately five times the germicidal power of phenol, while the others were found to increase steadily in power up to the most active member, hexylresorcinol, which was originally described as approximately fifty times as powerful as phenol but is now known to possess a phenol coefficient somewhat in excess of 70.[14] This compound has received very close pharmacologic and clinical study during the past three years,[15] and is now widely used as an internal antiseptic.[15] It is by far the most powerful germicide ever described as a nontoxic substance.

The interest attaching to a full investigation of the alkyl resorcinols as internal antiseptics has, until recently, left little room for a consideration of their possible usefulness in the disinfection of skin and mucous surfaces, a field that would have ordinarily been investigated first. A fairly thorough acquaintance with the properties and peculiarities of the individual members of the series, accumulated through these investigations, has made an examination of the entire group, with reference to surface disinfection, a relatively simple matter.

Saturated aqueous solutions of even the more powerful alkyl resorcinols are almost tasteless and slightly astringent. They are practically devoid of irritant properties and may even be swallowed with impunity. The fact that these solutions are very strongly and rapidly

13. Dohme, A. R. L.; Cox, E. H., and Miller, Ellis: J. Am. Chem. Soc., 48: 1688, 1926.

13. Hampil, B.: To be published. Footnotes 2 and 3.

14. Footnote 13, first reference.

15. Elliott, D. C., and Barbour, H. G.: Canad. M. A. J., 15: 787 (Aug.) 1925. Leonard, Veader: J. Urol., 12: 585 (Dec.) 1924. Leonard, Veader, and Frobisher, Martin: J. Urol., 15: 1 (Jan.) 1926; Tr. Am. Assoc. G.-U. Surg., 18: 333, 1925. Leonard, Veader: Science, 62: 408, 1925. Leonard, Veader, and Wood, Austin: J.A.M.A., 85: 1855 (Dec. 12) 1925. Henline, R. B.: J. Urol., 14: 119 (Aug.) 1925. Scott, W. J., and Leonard, Veader: Am. J. Dis. Child., 31: 241 (Feb.) 1926. Wynne, H. M. N.: Minnesota Med., 9: 156 (April) 1926. McCurry, W. E.: J.A.M.A., 84: 1950, 1925. Brown, D. A.: J.A.M.A., 86: 668 (March 6) 1926. Feirer, W. A., and Leonard, Veader: J. Pharmacol. & Exper. Therap., 28: 395 (Sept.) 1926. Feirer, W. A.,; Meader, P. D., and Leonard, Veader: J. Urol., 16: 97 (Aug.) 1926. Helmholtz, H. F.: Am. J. Dis. Child., 32: 396 (Sept.) 1926. Meader, P. D., and Feirer, W. A.: J. Infect. Dis., 39: 237 (Sept.) 1926.

germicidal suggested an investigation of the group with reference to their application as oral antiseptics. The remainder of this paper is devoted to an account of these experiments.

ALKYL RESORCINOLS

Summarizing our present knowledge of the alkyl resorcinols with reference to the six qualifications enumerated above, we find that, as a group, they more nearly approximate this ideal than any other phenolic germicides known, chiefly because of their lack of toxicity and irritant properties in highly bactericidal dilutions.

1. *Chemical Stability.*—All of the alkyl resorcinols are chemically stable compounds. Aqueous solutions retain their bactericidal properties after months of standing at room temperature.

2. *Toxicity.*—All of the alkyl resorcinols may be regarded as nontoxic substances. Laboratory animals tolerate large doses. The most powerful member of the series, hexylresorcinol, may be administered to man in doses of 0.6 gm. three times daily, indefinitely, without toxic effect.[16]

3. *Irritant Properties.*—All of the alkyl resorcinols can be held in the mouth in saturated aqueous solutions without discomfort.

4. *Bactericidal Power.*—All of the alkyl resorcinols are powerful germicides. Their phenol coefficients determined in accordance with the U. S. Hygienic Laboratory method in hundreds of experiments by Rettger and his associates at Yale University, by Frobisher at the Johns Hopkins Medical School and by Hampil at the Johns Hopkins School of Hygiene and Public Health may now be fixed as follows: propylresorcinol, $C_6H_3(C_3H_7).(OH)_2$ 5; butylresorcinol, $C_6H_3(C_4H_9).(OH)_2$22; amylresorcinol, $C_6H_3(C_5H_{11}).(OH)_2$54; hexylresorcinol, $C_6H_3(C_6H_{13}).(OH)_2$72; heptylresorcinol, $C_6H_3(C_7H_{15}).(OH)_2$49; octylresorcinol, $C_6H_3(C_8H_{17}).(OH)_2$0.

The iso-alkyl resorcinols are also powerful germicides, but are less powerful than the corresponding normal derivatives in each case.

The bactericidal power of the alkyl resorcinols is really greater than is reflected in these phenol coefficients since they are nearly ten times more bactericidal to the ordinary gram-positive pyogenic cocci, such as *Staphylococcus aureus*, than to the gram-negative organism (*B. typhosus*) employed in these tests, in spite of the fact that the former is considered to be by far the most resistant organism.

The bactericidal action of these compounds is very rapid. This observation was first made by Rettger working with butylresorcinol.[17] We have since found that saturated aqueous solutions of the more powerful members of this series completely destroy bacteria exposed to their action in fifteen seconds.

Penetrability.—All of the alkyl resorcinols markedly reduce the surface tension of water. This surface tension depressant action runs parallel with the bactericidal power of the various members of the group and is most pronounced in hexylresorcinol. As a surface tension reducent, hexylresorcinol is practically equivalent to the soaps.

Organic Matter.—Rettger has observed that butylresorcinol is extremely stable in the presence of organic matter, losing only about 10 per cent of its bac-

16. Damon, S. R.: J. Am. Pub. Health Ass'n., to be published.

17. Personal communication.

tericidal efficiency in the presence of 3 per cent gelatin and peptone. All of the other alkyl resorcinols lose a considerably greater percentage of their activity in the presence of this standard organic mixture.

In summary, then, the individual compounds comprising the alkyl resorcinols are all similar in their properties. Butylresorcinol stands out on account of its extreme stability in the presence of organic matter, while hexylresorcinol is characterized by its greater bactericidal power and penetrability. *Staphylococcus aureus* and *B. typhosus* are completely destroyed on fifteen seconds exposure to aqueous solutions containing 2 per cent of peptone and 1 per cent of gelatin with either butylresorcinol or hexylresorcinol added in concentrations as low as 0.1 per cent. The other alkyl resorcinols are inferior to these two compounds under these conditions.

THE BACTERICIDAL ACTIVITY OF PASTES CONTAINING BUTYLRESORCINOL AND HEXYLRESORCINOL

Since it appeared that the choice lay between butylresorcinol, hexylresorcinol or a combination of these substances, a series of pastes were prepared consisting essentially of gelatin, glycerine, water and chalk, with various concentrations of the butyl and hexyl derivatives ranging from 0.16 to 1 per cent.

The bactericidal activity of these pastes was then determined in the following manner:

Technic.—To 10 gm. of the paste accurately weighed, 40 c.c. of sterile distilled water was added at 20 C. The flask was then agitated until this material was completely homogenized, and 5 c.c. portions of this material were then transferred to sterile test tubes by means of a sterile graduated pipet, the plugs reinserted and the tubes immersed in a water bath held at 37 C., where they remained throughout the experiment.

The strains of *Staphylococcus aureus* and *B. typhosus* employed as test organisms have been described elsewhere.[4] These were transferred daily and fresh twenty-four hour broth cultures used exclusively.

One series of tubes was then inoculated with one standard 3 mm. loopful of *Staphylococcus aureus* and another with one standard 3 mm. loopful of *B. typhosus*, the tubes being agitated after inoculation and immediately replaced in the water bath.

At intervals of fifteen, thirty and sixty seconds after each inoculation, the tube was agitated, and one standard 3 mm. loopful of the material transferred to a tube of fresh infusion agar and a plate poured. All plates were then incubated for forty-eight hours at 37.5 C.

As controls, the same procedure was carried out with each test organism in 5 c.c. physiologic sodium chlorid solution.

The results of these experiments are shown in Table 1.

The fifteen second interval employed in these experiments was not decided on offhand. The astonishing rapidity with which these pastes were found to destroy the test organisms, even when diluted with 4 parts of water, was at first underestimated, and necessitated the adoption of shorter and shorter time intervals. As fifteen seconds affords barely sufficient time, working very rapidly, to carry out the necessary movements, a shorter time exposure could not be employed.

The higher concentrations were orig-

inally employed because these pastes were all well borne in the mouth. The 0.33 and 0.16 per cent pastes were made up only when it was found that the stronger preparations destroyed the test organisms so rapidly that the time could not be estimated. Concentrations below 0.16 per cent have not been investigated.

The superiority of hexylresorcinol is plainly evident in these results. While pastes containing 0.16 per cent of hexylresorcinol destroyed both test organisms in fifteen seconds, those containing double this amount of butylresorcinol failed to kill *Staphylococcus aureus* in thirty seconds.

A curious retardation of the bactericidal action of hexylresorcinol in pastes containing this substance in combination with butylresorcinol is shown in Table 1. While this phenomenon is not always observed in pastes containing both substances in various proportions, it occurs quite frequently. These pastes may be potentially as bactericidal as would be expected from their total alkyl resorcinol content, but when the time of exposure is shortened to below sixty seconds, it becomes evident that the butyl resorcinol prevents the almost instantaneous destruction of the test organism by the hexylresorcinol, which

TABLE 1.—THE VELOCITY OF BACTERICIDAL ACTION OF PASTES CONTAINING HEXYLRESORCINOL AND BUTYLRESORCINOL ALONE AND IN COMBINATION*

Alkyl Resorcinol Content of Paste	Staphylococcus Aureus			B. Typhosus		
	15 sec.	30 sec.	60 sec.	15 sec.	30 sec.	60 sec.
1% Hexylresorcinol	0	0	0	0	0	0
3/4% Hexylresorcinol	0	0	0	0	0	0
2/3% Hexylresorcinol	0	0	0	0	0	0
1/2% Hexylresorcinol	0	0	0	0	0	0
1/3% Hexylresorcinol	0	0	0	0	0	0
1/6% Hexylresorcinol	0	0	0	0	0	0
1/2% Butylresorcinol	0	0	0	0	0	0
1/3% Butylresorcinol	+	+	0	0	0	0
1/6% Butylresorcinol	+	+	+	0	0	0
1/3% Hexylresorcinol 1/6% Butylresorcinol	+	+	0	0	0	0
Controls Salt Sol.	+	+	+	+	+	+

*O, test organism killed; +, failure to kill test organism.

would otherwise occur. A satisfactory explanation of this phenomenon remains to be determined.

The bactericidal action of 20 per cent aqueous solutions of pastes containing 0.5 and 0.33 of hexylresorcinol was then determined, a variety of test organisms being employed by the technic described above. All organisms were completely destroyed by both preparations in fifteen seconds.

The bactericidal action of 20 per cent aqueous solutions of pastes containing only 0.16 per cent of hexylresorcinol, was next determined, the following test organisms being employed: pneumococcus, Type I; pneumococcus, Type II; *Streptococcus viridans; Streptococcus hemolyticus; Staphylococcus albus; Staphylococcus aureus; Bacillus hofmanni; Bacillus proteus; Bacillus coli; Bacillus typhosus; Bacillus diphtheriae,* and *Spirillum metchnikovi.*

All of these organisms were completely destroyed in fifteen seconds. The technic employed was precisely that described above. Vigorous growth occurred in all of the controls. Spirochetes, ameba and flagellates disintegrate immediately on contact with a 20 per cent aqueous solution of this paste.

Figure 1 shows the appearance of the fifteen second plate of *Staphylococcus aureus* as compared with the control. The plates of the other organisms show the same picture, and for this reason only one typical example is reproduced. The fact that none of the forty-one tooth pastes recently examined, irrespective of claims to antiseptic action, were found to be capable of destroying *Staphylococcus aureus* under these same conditions, even on five minutes exposure in the test tube, while pastes containing concentrations of hexylresorcinol, so small as to be barely discernible in the mouth, completely destroyed this and many other types of organisms in one-twentieth part of this time, is of considerable interest, as indicating that the problem of oral antisepsis may not be as hopeless as it has been generally considered to be in the past.

Fig. 1.—Destruction of Staphylococcus aureus on fifteen seconds exposure to a 20 per cent solution of paste containing 0.16 per cent hexylresorcinol. The control plate is on the left.

REDUCTION OF THE BACTERIAL CONTENT OF MOUTH WASHINGS

No satisfactory technic by which the actual number of viable organisms present in the mouth can be even roughly estimated has ever been devised. A certain amount of information may be had by observing the bacterial content of definite quantities of water that have been forced about in the mouth for a definite time. By comparing the bacterial content of mouth washings, in this manner, before and after carrying out a given procedure in the mouth, valuable information can be obtained as to the bactericidal activity of the preparation employed, under practical conditions of application in the mouth. It cannot be emphasized too strongly that this method gives us no information whatever as to the actual number of viable organisms remaining in the mouth after such procedures.

The statements frequently encountered, advertising this or that preparation as capable of reducing the number of bacteria in the mouth by from 70 to 90 per cent, are obviously fallacious. Even were this actually true, which is most unlikely, there is no known method of proving it. Accurate information as to the bactericidal properties of various preparations can be determined in the test tube, and then, by means of the procedure indicated above, their relative value, as applied in the mouth can be satisfactorily compared.

Technic.—The details of the procedure followed in all of the experiments to be described were as follows:

A mouth rinse consisting of 25 c.c. of water, swished about in the mouth and forced between the teeth for one minute, was ejected into a sterile tumbler, to serve as a control.

The teeth and gums were then scrubbed vigorously for one minute by the watch, with a moistened toothbrush of "medium" stiffness, the bristles of which were completely covered with the paste under examination, after which the mouth was rinsed thoroughly with water. Ten minutes later, and again thirty and sixty minutes later, 25 c.c. mouth rinses, treated precisely as the control rinse, were obtained.

The control rinse and all subsequent rinses were diluted with sterile physio-

TABLE 2.—THE AVERAGE NUMBER OF ORGANISMS PER CUBIC CENTIMETER CONTAINED IN MOUTH RINSES BASED ON 129 OBSERVATIONS IN ELEVEN INDIVIDUALS

Subject	Number of Counts	Average Number of Organisms per Cubic Centimeter in 25 C.c. Rinse
A	11	2,564,000
C	10	1,660,000
D	11	434,000
F	6	43,600,000
G	5	5,140,000
L	4	8,000,000
M	7	4,486,000
N	14	24,964,000
O	27	13,764,000
P	17	16,470,000
Q	17	21,470,000
Average 11 subjects		13,000,000
Average 129 counts		14,000,000

logic sodium chlorid solution immediately on being obtained, to prevent possible multiplication of their bacterial content or possible action on the part of the small amounts of germicide that they might contain. Accurately pipetted amounts of each dilution were then plated in fresh beef infusion agar to determine the number of viable organisms per cubic centimeter contained in the various rinses. All plates were incubated for forty eight hours at 37.5 C. before counting.

The number of organisms per cubic centimeter contained in 25 c.c. mouth rinses of water, obtained under these conditions among eleven individuals in whom four or more determinations had been made at various times of the day, over a period of three months, are recorded in Table 2. These figures are derived from the counts made of 129 mouths rinses obtained as controls in various experiments and are recorded in this place merely for the reason that information of this nature does not appear to be available in the literature.

Seventy-five experiments were made among seventeen subjects, with pastes containing hexylresorcinol alone in concentrations of 1, 0.75, 0.66, 0.50 and 0.33 per cent, exactly in accordance with the procedure described above. The average number of organisms per cubic centimeter in the mouth rinses obtained at intervals of ten, thirty and sixty minutes after brushing the teeth showed a reduction in each case as compared with the corresponding controls varying from 21 to 98 per cent in individual experiments, and average reductions in group experiments varying from 63 to 86 per cent. The results obtained with pastes containing only 0.33 per cent of hexylresorcinol were entirely comparable to those containing higher concentrations.

Fifteen experiments were made among five subjects with pastes containing butylresorcinol alone and also in combination with equal quantities and with double quantities of hexylresorcinol. The total alkyl resorcinol content of these pastes varied from 0.33 to 1 per cent.

The reduction obtained with the butylresorcinol pastes was smaller than that observed with pastes containing the same concentration of hexylresorcinol, employed by the same individual.

Pastes containing combinations of hexylresorcinol and butylresorcinol showed satisfactory reductions in some individual experiments, but the results were, on the whole, very inconstant. Furthermore, the reductions observed were usually no greater, and often not so great, as those that would have been expected from the amount of hexylresorcinol present.

Two conclusions were drawn from these experiments: (1) in pastes containing more than 0.33 per cent of hexylresorcinol, there was an excess of the germicide that did not materially increase the efficiency of their germicidal action in the mouth, and (2) the incorporation of butylresorcinol in these pastes not only failed to increase their efficiency, but also frequently prevented the full action of the hexylresorcinol present. Accordingly, butylresorcinol was omitted in further experiments and the concentration of hexylresorcinol was reduced to 0.16 per cent.

In a group experiment among six individuals with this paste, the results were distinctly inferior to those obtained with the higher concentrations. A way was found to increase the bactericidal

TABLE 3.—THE INFLUENCE OF SODIUM BICARBONATE ON THE EFFICIENCY OF PASTES CONTAINING 0.33 AND 0.16 PER CENT HEXYLRESORCINOL

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Alkali Content	Percentage Reduction in Number of Organisms per Cubic Centimeter Contained in 25 Cc. Mouth Rinses. Obtained at Intervals of 10, 30 and 60 Minutes After Brushing Teeth											
	With Pastes Containing 0.33 Per Cent Hexylresorcinol						With Pastes Containing 0.16 Per Cent Hexylresorcinol					
	Subject	Ave. 10-30 Min. Counts		Ave. 10-30-60 Min. Counts			Subject	Ave. 10-30 Min. Counts		Ave. 10-30-60 Min. Counts		
		Per cent		Per cent				Per cent		Per cent		
None	A	70	Group average 81% reduction	71	Group average 78% reduction		A	93	Group average 64% reduction	91	Group average 56% reduction	
	C	83		75			D	70		71		
	D	90		71			F	30		21		
	F	83		85			G	50		30		
	O	68		74			O	75		78		
	Q	92		94			Q	65		47		
Sodium 5% bicarbonate	B	65	Group average 62% reduction	72	Group average 62% reduction		A	91	Group average 76% reduction	90	Group average 75% reduction	
	C	90		63			C	86		75		
	F	35		53			D	87		88		
	I	34		37			G	40		48		
	J	69		73			H	69		67		
	O	78		78			O	71		72		
							Q	89		88		
1% Sodium bicarbonate	A	62	Group average 76% reduction	66	Group average 75% reduction		A	82	Group average 73% reduction	76	Group average 72% reduction	
	C	81		83			C	86		72		
	D	88		83			D	25		35		
	H	70		70			G	60		56		
	O	89		90			H	70		79		
	Q	64		59			O	95		94		
							Q	92		92		

efficiency of this paste without increasing the hexylresorcinol content as follows:

Although hexylresorcinol is readily soluble in pure glycerine, which all of these pastes contained, as well as in dilute alkali, it is soluble in water only to the extent of about 1 part in 5,000. While aqueous solutions of hexylresorcinol destroy staphylococci in one hour in dilutions as high as 1 part in 100,000 parts of water, it was felt that all of the drug present in the paste (1 part in 600 parts) might not pass into solution in the mouth immediately. Accordingly, 5 per cent of sodium bicarbonate was incorporated in these pastes, insuring instant solution of all of the hexylresorcinol present. Group experiments then showed that pastes containing 0.16 per cent of hexylresorcinol, together with 5 per cent of sodium bicarbonate, gave as good results as those containing 0.33 per cent of hexylresorcinol alone.

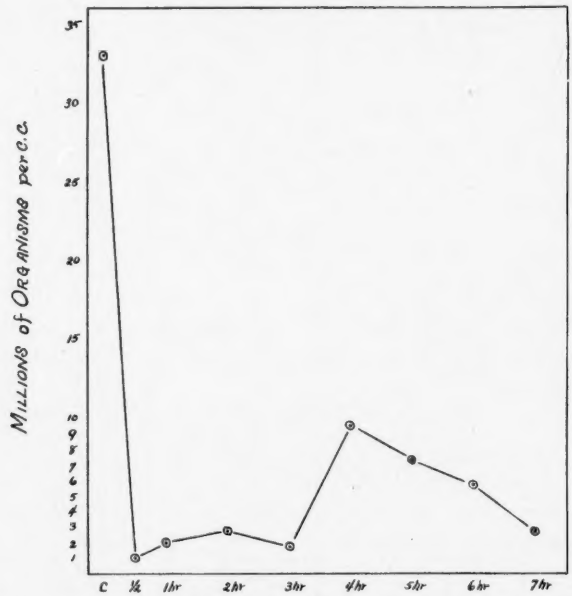

Fig. 2.—Curve showing duration of reduction in bacterial content of mouth washings during seven hours of fasting after the application of hexylresorcinol paste.

Later, it was found that the concentration of sodium bicarbonate could be reduced to 1 per cent. Sodium carbonate and milk of magnesia gave inconstant results.

The results obtained in group experiments with pastes containing 0.16 and 0.33 per cent of hexylresorcinol, with and without the incorporation of sodium bicarbonate, are shown in Table 3. The technic employed was precisely that

described above. In view of these results, it would appear that the paste containing 0.16 per cent of hexylresorcinol, with 1 per cent sodium bicarbonate, is as efficient in reducing the bacterial content of mouth washings as those containing greater concentrations of hexylresorcinol.

In view of the wide variations observed in individual experiments, the remarkable constancy of the percentage reductions shown in the group averages was a matter of some surprise.

The duration of the reduction in the bacterial content of mouth washings following the application of hexylresorcinol pastes requires further study. The results of an experiment of this nature are shown in Figure 2, the teeth and gums having been scrubbed for one minute with a paste containing 0.33 per cent of hexylresorcinol without alkali, and observations made during the next seven hours, during which time the subject fasted.

Comment.—It should be emphasized in this place that the problem of oral antisepsis is by no means solved. The remarkable biologic properties of the alkyl resorcinols, as a group, suggested their possible application as surface disinfectants, and the field of oral antisepsis was chosen for preliminary investigations as offering perhaps better chances for securing fundamental information relative to surface disinfection, because of the difficulties presented in this field, rather than in spite of them. It is highly probable that a satisfactory solution of the problem of oral antisepsis would be immediately applicable to any tissue surface.

Before this is possible, better methods must be devised for the determination of the actual number of organisms present on tissue surfaces, and either more efficient methods of applying known antiseptics must be found or new bactericidal substances must be synthesized that more nearly approach the ideal. The work presented in this paper is regarded, and should be regarded, as merely indicating that a completely satisfactory solution of the problem of oral antisepsis is not entirely hopeless.

CONCLUSIONS

1. A substance intended for use as an oral antiseptic should be chemically stable, nontoxic, nonirritating, rapidly bactericidal in high dilution, highly penetrating and unaffected by organic matter. No such substance is known. As a group, the alkyl resorcinols more nearly meet these conditions than any other type of germicide, and of these, hexylresorcinol is by far the most efficient.

2. As indicated in the material presented, 20 per cent aqueous solutions of pastes consisting essentially of gelatin, glycerin and chalk with 1 per cent of sodium bicarbonate and 0.16 per cent of hexylresorcinol destroy all of the common pathogenic bacteria in fifteen seconds.

3. Applied in the mouth, pastes of this composition reduce the bacterial content of mouth washings from 25 to 94 per cent in individual experiments and over 70 per cent in group experiments. This reduction may persist for several hours.

THE ADAPTATION OF MILITARY SURGERY TO CIVIL PRACTICE*

By REA PROCTOR McGEE, M.D., D.D.S., Los Angeles, California

THE experience of war taught us that the human face can endure almost any degree of mutilation without death of the patient. We know that fragments of bone, muscle, cartilage, mucous membrane and skin apparently hopelessly lost may be rescued by the surgeon, if the patient is seen within a reasonable time after the injury. We learned, too, that it is possible to restore, passably, the appearance of any feature and frequently the function as well.

Also, military experience taught us that, before constructive surgery can be safely attempted, the area of injury must not only be free from sepsis and from the presence of foreign bodies, but must also have its circulation restored as nearly as possible to the normal.

The psychologic factors of face mutilation were not thoroughly appreciated until the Great War. From our experiences, we realized not only that reparative surgery is necessary and desirable to restore function for the benefit of the patient, and appearance for the benefit of others, but also that the mental processes of the patient may sometimes be restored to normal by restoring the face as nearly as possible to its previous appearance.

In civil practice, we have learned to wait. Undue haste in plastic surgery is the surest method of failure. After the field of operation has reached the state where plastic surgery is indicated, the limit of time that may be allowed to lapse between the necessary steps in surgical procedure must be exaggerated always rather than minimized.

In operations that go through many stages, allowance must always be made for the patient to recover healing ability. We presume that the repair of tissue and the adherence of grafts is due to good circulation, healthy tissue and normal nutrition. But there is something further in these cases, and that is the ability of the human economy to maintain circulation necessary for repair at a given point. When the patient has been called on for repair with undue frequency, even though all of the conditions necessary for healing are apparently present, we find that Nature occasionally does not take kindly to repeated operations. Rest then becomes necessary, and, after a period which varies with the individual, this property of Nature may be restored.

Among the surgical procedures that were developed in the military hospitals, one of the most valuable was that of the inlay graft. This graft is made by gently forcing modeling compound into the incision, then raising a Thiersch graft from the desired spot and placing the graft, raw side out, over the mold, burying the mold in the incision, and

*Read before the Section on Military Surgery at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 23, 1926.

holding it there either by a mechanical appliance or with sutures. The variations of this graft are almost innumerable.

It was first used to place epithelium in the areas of lost mucous membrane of the mouth; then, it was applied to the lost mucous membrane of the nose; then, to the eyelids, both the conjunctival area and the cutaneous surface, this method being used to relieve both entropion and ectropion as well as symblepharon. It is now used in vaginal, rectal and urethral repair work. The same method is applicable for grafting skin between the fingers on burned hands, and for all areas wherein skin grafting is an intricate process.

Another thing we learned in the military service that is of use in civil practice is the fact that all skin grafts should be placed with a reasonable amount of pressure. The Wolfe graft in particular lends itself to pressure from a modeling compound mold.

A B

Fig. 1 (Case 1).—*A*, appearance of patient in whom a noma had obliterated the right upper culdesac of the mouth. *B*, normal expression after operation.

There is no question that the extensive facial plastic surgery that was performed in the War has increased manyfold the chances for life of civilian patients who suffer from malignant neoplasms of the face. Before we learned featural surgery as we now

know it, operations on sarcoma, carcinoma and epithelioma of the face was seldom carried out with the freedom of operation on the same growths in other parts of the body. As a result, the great majority of operations for malignancy in the facial region were minimized for the sake of retaining at least some semblance of the human face. But with our present knowledge of restorative and reparative surgery, it is the best practice to cut away malignant areas freely, so that the patient may have the fullest benefit from surgical interference. If the operation is successful, a new face, or at least a part of a new face, can be built up on the field of operation.

The geometric incision and the great variety of autogenous grafts that the clinical facilities of the military hospitals allowed us to work out are now applied with facility in civil cases; in fact, civilian facial plastic surgery is almost an exact duplication of the wartime surgery of the face.

A B

Fig. 2 (Case 2).—*A*, appearance of patient in whom triangular piece of bone was broken from lower border of orbit and driven into antrum. *B*, result of operation.

REPORT OF CASES

CASE 1.—Figure 1*A* shows a woman who had suffered from noma when 5 years of age. This caused the obliteration of the upper culdesac of the mouth on the right side, drawing inward and upward of the right angle of the lower lip, loss of expression on the right side, and movement of the mouth to such an extent that she apparently had Bell's palsy.

You will notice that the nasolabial line on the left is very pronounced, while on the right it is hardly visible; also that the commissure of the mouth is about one-quarter inch longer on the left than on the right. The operation in this case was of the inlay graft type. An incision was made into the superior culdesac, extending from the pterygoid process upward to the malar bone and forward to the region of the lateral incisor. Fortunately, for my purpose, she was wearing a small partial plate. To this plate, before operating, I had a wire loop vulcanized. This apparatus was sterilized, and, at the time of operation, modeling compound was laid over it and it was forced into the incision, increasing the area of the culdesac to about twice the desired extent. A Thiersch graft from the palmar surface of the left arm was made and laid raw side out over the mold, which was then inserted in position and left for seven days, when it was removed, and the graft was found to have taken satisfactorily. The mass of plastic material was then cut down somewhat, and the plate reinserted, being removed daily for cleansing. The plate was retained for a month, with occasional paring down of the

compound or with replacement by fresh compound, so that the new culdesac was retained. You will see from Figure 1*B* that a normal expression has been gained.

after the accident. The injury was repaired by dissection under the upper lip to the orbital border. An impression with modeling compound was made of the defect. A piece of

A B

Fig. 3 (Case 3).—*A*, case of congenital nevus pigmentosa. *B*, improvement after operation.

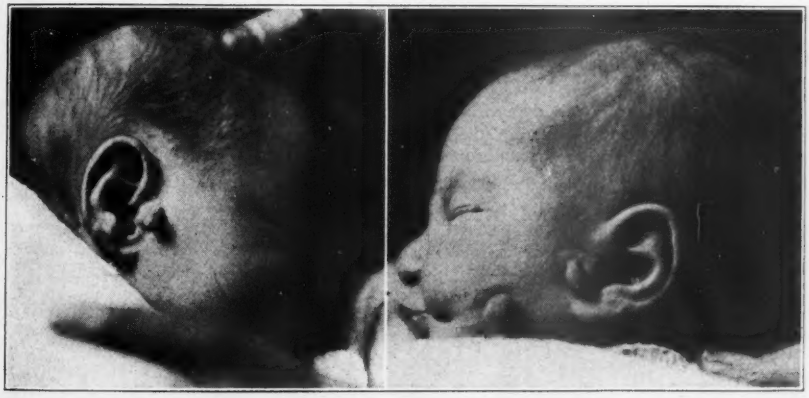

Fig. 4 (Case 4).—Appearance of infant, showing pedunculated growths.

CASE 2.—Figure 2*A* shows a woman who was injured in an automobile wreck, her face being driven against the throttle. A triangular piece of bone was broken from the lower border of the orbit and driven into the antrum. I saw the case six months

costal cartilage from the eighth rib was cut to the size and shape indicated by the impression, and was sutured into place and allowed to remain undisturbed three months. An incision was then made on the deepest wrinkle of the lower eyelid, with a blunt

dissection downward, following the course of the traumatic crease in the face. A piece of fat was cut from the under surface of the upper arm and inserted through the opening of the eyelid, which was then closed with fine braided silk sutures. Figure 2*B* shows the result.

Fig. 5 (Case 4).—Appearance of infant, showing congenital macrocheilia.

CASE 3.—The next case is that of a congenital nevus pigmentosa covering the left side of the face, from the commissure of the left eye to the lower border of the upper lip, from the side of the nose and center of the lip, to the ear. This birthmark, while always unsightly, had not had any appearance of malignancy until about two years previously, when warty nodules, visible in Figure 3*A*, began to appear. These suggested epithelioma, and in order to forestall such a development, I made an incision from the nose under the lower border of the eyelid, to the ear, and downward and back to the nose on a line with the top of the ala, and up the nose to the original point of incision. This irregular portion of skin was then dissected loose, the entire layer of skin being removed. I found that the blue was so persistent that a considerable layer of fat which had the same type of blue discoloration had to be cut away. This would indicate that, in some of these nevi, there is a considerable involvement of abnormal pigmentation and that the whole discoloration does not depend on the deformity of the blood vessel. The denuded area was grafted with a full thickness Wolfe graft from the arm. After this graft had healed, the lower eyelid and the upper lip were treated for a considerable period with coagulation by means of the high frequency current dessication with the needle and exposure to the rays of the water-cooled ultraviolet quartz lamp.

The result was a decided improvement in the appearance of the patient, who had heretofore felt compelled to wear a thick veil whenever she appeared on the street (Fig. 3*B*.)

Fig. 6 (Case 4).—Results of operations on pedunculated growths and macrocheilia.

CASE 4.—The next case is that of an infant that was born with two growths about the size of the end of a finger on one cheek, and one on the other. (Fig. 4.) The mouth showed congenital macrocheilia extending well into the left cheek, as shown in Figure 5. The operation in this case was the removal of the pedunculated growths, suturing the skin together after tying the artery, restoring the mouth to normal size by operating on the mucous membrane and the skin from the muscle layers, closing the muscle with buried plain catgut sutures, and closing the skin with fine silk. The corner of the mouth was repaired by bringing a mucous flap from the upper lip downward into the lower. This reproduced the columella of the corner of the mouth. Figure 6 shows the result.

DISCUSSION

Henry S. Dunning, New York City: There is a difference between the civil plastic surgery that we are called on to perform and that of military cases. Most of the civil cases are comparatively clean, or can be made so in a short time, and the patient is not suffering very much from a great loss of tissue except in cases of extensive neoplasms and burns. Recent military cases have been very dirty, most of the patients having a week's beard, and, although in the prime of life, they have undergone such great hardships, including exposure to the elements and often lack of food and sleep, that they are not, generally speaking, in such good physical condition and their resistance is not so good as that of patients in civil life. I would say that little can be done very early for soldiers that have suffered severe facial injuries at the battle front, because of their poor physical condition, often, and also because they cannot be gotten sufficiently early to a hospital where permanent work can be started before suppuration sets in. In other words, it is almost impossible, with the roads in a choked condition toward the front, to transport the wounded back to the base hospitals before their wounds become seriously infected. If one could operate in these cases in two or three hours, much could be accomplished, but in the majority of cases, we find that it would take three or four days to get the patient to a base hospital where the operating rooms and material were sufficient to permit of carrying out extensive repair work. By this time, they are in such condition that they would have to be treated for a considerable length of time to clean them up sufficiently for even preliminary operation before the main reconstruction work could be done. I would say that most of the work has to be done in the mobile and evacuation hospital and the casualty clearing stations, where we approximated and immobilized the parts by splinting and other means. Then we had the patient sent at the earliest possible moment to a permanent hospital, where the wound could be dressed and treated for an interminable length of time. I agree with Dr. McGee that the work done in the Army has been of the utmost importance to the men practicing civil maxillofacial surgery. The material was unlimited and of such a character that the surgeon had to resort to all sorts of expediencies to cope with the horrible injuries. This brought out all the ingenuity and also much courage that otherwise would have remained dormant in the average practitioner, as many men would not have dared to attempt on civil patients the things that they were forced to do in the emergency of war. Maxillofacial surgery probably gained more of an impetus through the work done during the recent war than any other specialty with the exception of orthopedic surgery and that of the lungs and thoracic cavity. We learned a great deal from our allies and will ever owe them a great debt of gratitude for all that they did in telling us of their mistakes and advising us how to proceed from time to time with certain difficult cases. Regarding certain cases that Dr. McGee spoke of, I feel sure that he is right when he says that, in extensive necrosis, it is best to wait. We must always wait until the involucrum has formed and the dead bone has become sufficiently sequestered to be thrown off with practically no surgical interference. I also agree that circulation and infection play the greatest part in all plastic surgery, and the surgeon who does not pay careful attention to these two factors will meet misfortune.

RELATIONSHIP OF THE TEETH TO THE MANDIBULAR CANAL AND THE MAXILLARY SINUS*

By THESLE T. JOB, M.S., Ph.D., and RALPH H. FOUSER, B.S., D.D.S.,
Chicago, Illinois

VARIOUS studies have been made from time to time which involved the relationship of the teeth to the maxillary sinus and the mandibular canal. A. Hopewell-Smith,[1] Frederick B. Noyes,[2] J. Parsons Schaeffer,[3] and Hugh W. MacMillian[4] are a few of the authors who have made valuable contributions on the macroscopic relationship of the teeth to surrounding structures. Contributions on the minute anatomy of these relationships seem to be notably lacking. It is therefore the aim to present here the results of a study of the minute anatomy of the structures between the teeth and the maxillary sinus and the mandibular canal.

Serial sections have been made in all three planes at different ages of the human maxilla and mandible. As the material selected was from specimens with no evident pathologic condition in the mouth, it represents what is believed to be the normal anatomy. The illustrative material of this paper is selected to show the average conditions found in the specimens studied.

It should be mentioned that we recognize the great variability in the number of teeth related to the maxillary sinus, and the variability of the relationship of the third molar to the mandibular canal, but these facts do not enter into the realm of this paper, since it is only the minute anatomy of the intervening structures where the teeth are intimately related to the maxillary sinus and the mandibular canal that here concerns us.

MAXILLA

A minute examination of the tissues related to the maxillary sinus reveals a compact, laminated layer of bone forming the floor of the sinus. This bony layer is notably thinner than the lingual

*From the Department of Anatomy, Chicago College of Dental Surgery, Dental Department of Loyola University.

*Read before the Section on Exodontia, Anesthesia and Roentgenology at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

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and buccal plates of the alveolar process (Figs. 1 and 3). Furthermore, it is not a solid layer of bone but frequently perforated by the soft tissues (Figs. 1-4).

Fig. 1.—Frontal section of maxilla, showing lingual root of the first molar and the surrounding structures.

These perforations are, in the main, microscopic, and have a tortuous course through the bone. However, not infrequently, macroscopic foramina are seen.

Immediately below the floor of the maxillary sinus is a narrow zone of cancellous bone. The ratio of bone to medullary space in this area is worthy of special attention. Figures 2 and 4 illustrate this point. It is evident that the area of the medullary spaces is equal to, if not greater than, the area of the cancellous bone. The cancellous bone in this zone attaches directly the plate of bone in the floor of the maxillary sinus with the lamina dura of the apices of the roots of the teeth. Below this

thin zone of cancellous bone and lying between the roots of the teeth is a large medullary space (Figs. 1, 3 and 5). In the plane of the upper one half of the roots of the molars, this medullary space is spacious. Only rarely are plates of cancellous bone found bridging this space from buccal to lingual plate (Fig. 5).

The lamina dura is truly a much perforated layer of compact, laminated bone, with a narrow zone of cancellous bone associated with it except where the roots come in direct contact with the buccal and lingual plates of the alveolar process.

The perforations in the lamina dura vary greatly in size and number as well as in position. There is also a difference between the maxilla and mandible in this respect, there being a strong tendency for a greater number of openings to be present on the interproximal surfaces of the roots of the maxilla, while, in the mandible, the greater number of openings are toward the mandibular

Fig. 2.—Higher magnification of root-end region shown in Figure 1.

canal. This fact appears to be determined by the source of the largest blood supply.

PRACTICAL CONSIDERATION

The anatomic facts just pointed out have direct bearing on the treatment of these tissues and on the pathologic manifestations that are frequently found in this area. In curettage of this area, one should always remember the thinness of the layer of bone forming the floor of the maxillary sinus, the close proximity of the alveolae of the teeth to this layer of bone, and the definite attachment of the lamina dura to the floor of the maxillary sinus. In abscesses, the cribriform nature of the lamina dura and the floor of the maxillary sinus becomes important. The direct continuity of the soft tissues lining the maxillary sinus with the peridental membrane and the large medullary spaces, which is a constant anatomic fact (Figs. 2 and 4), permits easy metastasis.

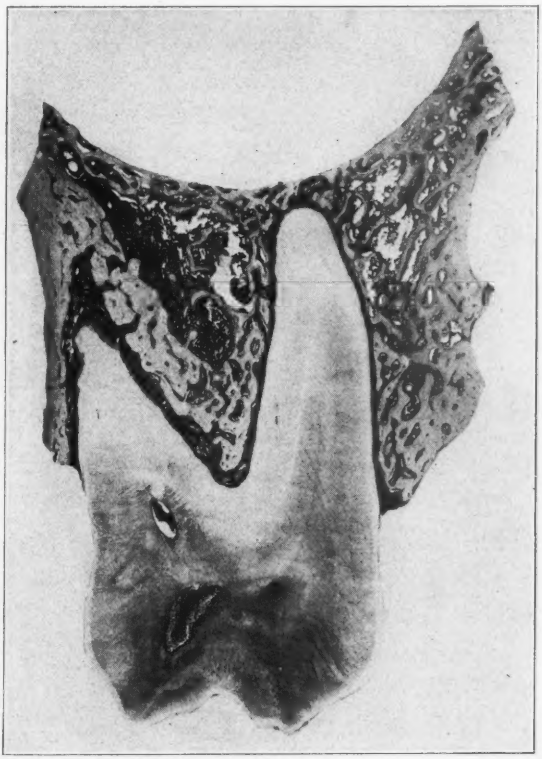

Fig. 3.—Frontal section of maxilla, showing slight tangential cut of the first molar and surrounding structures.

In interpreting radiograms, the irregular character and cribriform nature of the lamina dura should be considered. Not infrequently, enlarged openings are found in the lamina dura so located as to give the impression in radiograms of resorption areas, when, as a matter of fact, they are normal structures (Figs. 2 and 5). These facts hold true, though in a less intimate way, with those teeth not so closely related to the maxillary sinus (Fig. 6).

Fig. 4.—Higher magnification of root-end region of molar, showing relationship to the maxillary sinus and surrounding structures.

MANDIBLE

The mandible presents a somewhat different structural picture, yet the histologic features of the bone are of a similar character to those found in the maxilla. The compact bone, which comprises the buccal, labial and lingual plates, is thicker (Fig. 7); the haversian type of bone predominates in the alveolar plates. Cancellous bone is of the same general character as that found in the maxilla, although the smaller medullary spaces appear to be more numerous.

The wall of the mandibular or inferior dental canal is composed of a thin layer of compact, laminated bone that is extensively perforated, especially on the surface toward the apices of the teeth. It is surrounded throughout its course by cancellous bone. The canal is closely associated with the lingual plate (Fig. 8)

and continues forward to the region of the bicuspids, where it turns laterally to the mental foramen. This foramen terminates the canal proper, but the incisive branches of the inferior alveolar structures continue through the cancellous portion of the bone, between the bony plates, to be distributed to the cuspid and incisor teeth.

The third molar, owing to its position at or near the angle of the mandible, bears the closest relationship to the mandibular canal. The second and first molars are slightly more distant, as are the bicuspids.

PRACTICAL CONSIDERATION

The general character of the bony structures is much the same as in the maxilla, except that, in the mandible, we have the root ends of the teeth closely related to the mandibular canal. In the surgical treatment of chronic dento-alveolar abscess, frequently the operator injures the structures contained

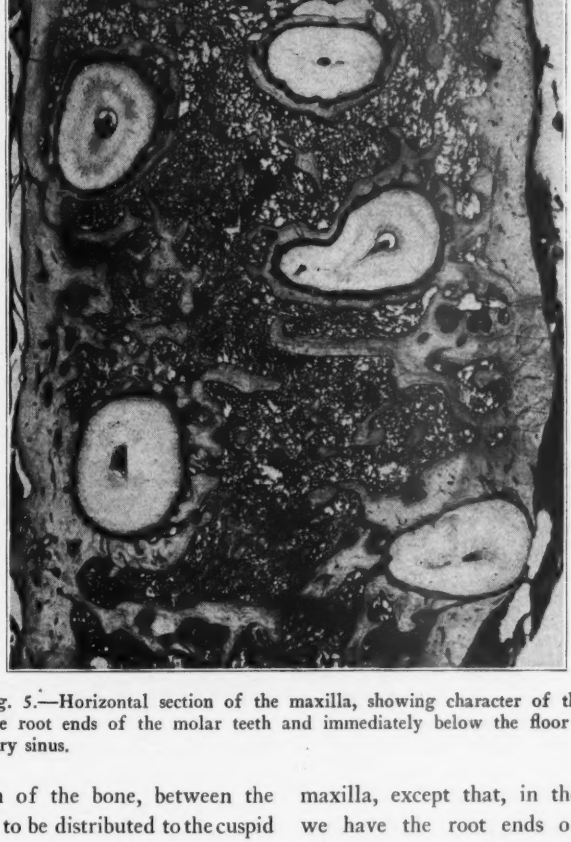

Fig. 5.—Horizontal section of the maxilla, showing character of the bone near the root ends of the molar teeth and immediately below the floor of the maxillary sinus.

in the canal. The character of the bone and the close promixity of the root ends to the canal make such injury possible (Fig. 8).

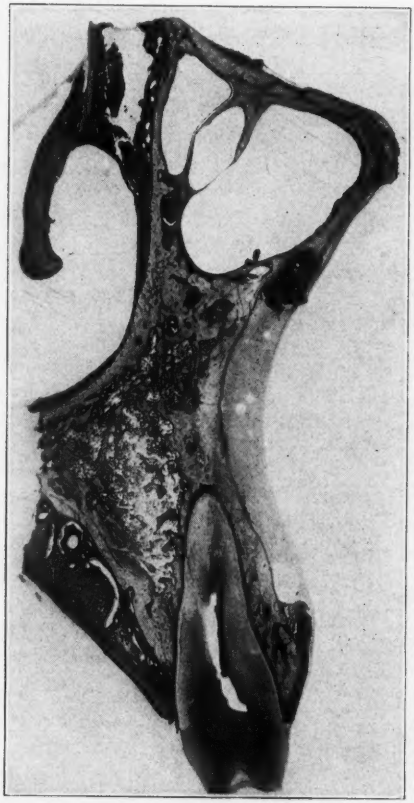

Fig. 6.—Frontal section of maxilla through the region of the second bicuspid (left).

CONCLUSION

A thorough knowledge and proper consideration of the anatomic structures of the maxilla and mandible are of basic importance. The structures under consideration bear a direct relationship to the pathologic changes that take place in these regions. In the correct interpretation of pathologic changes, it is not only necessary to understand the tissue manifestations but it is also essential to know the normal anatomy and relationships of the areas.

It is of the utmost importance that the

Fig. 7.—Frontal section of mandible in the region of the mesial root of the first molar.

operator have an accurate knowledge of the normal as well as the pathologic anatomy of these parts, as proper surgical intervention, when necessary, is based upon the scientific knowledge of the anatomic, physiologic and pathologic character of the parts.

We hope that this contribution may help bring about a more accurate understanding of these basic factors and a

more accurate interpretation of the pathologic changes occurring in these areas, and may result in more scientific surgical treatment.

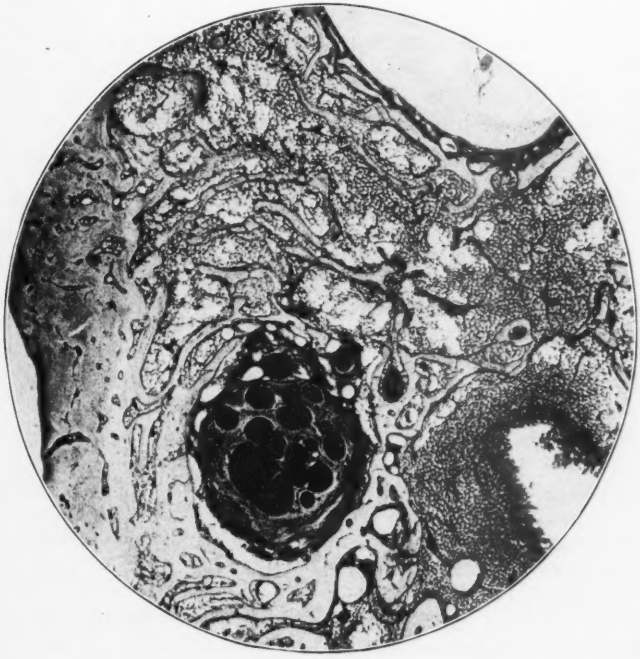

Fig. 8.—Higher magnification of root-end region shown in Figure 7. Note the lingual plate of compact bone; the mandibular canal and contents, and the apical region.

DISCUSSION

Alonzo Nodine, London, England: This annihilates another of those fallacies with which the dental profession is obsessed. The fact that the lamina dura is intact has been considered, for some time, as indisputable proof that the tooth is not only free from infection but even safe and savable. The lamina dura has been considered as certain a barrier against the exit of micro-organisms as that dense layer of tissue between the dentin and the cementum. This research discloses that the lamina dura, instead of being a barrier, is a sieve. The numerous channels shown in the slides as extending through this structure are conclusive and convincing evidence of this fact. The infection within the tooth may be conveyed beyond the tooth into the circulation by means of these channels and infect any tissue or organ for which they have an affinity.

OPERATIVE PROCEDURE IN CLEFT PALATE AND HARELIP*

By CHALMERS J. LYONS, D.D.Sc., Ann Arbor, Michigan

THE subject of cleft palate and harelip has been extensively discussed in the past from almost every angle and point of view. It would seem that there are a few fundamental principles in the operative procedure on which all those who are interested might agree and which might be standardized. It seems strange that, with all that has been written in the past from the larger clinics by recognized authorities in this work, and with all the teaching during the past years, there are still so many men having little knowledge of the underlying principles that govern the success or failure of the operation who are attempting to operate on these unfortunate children.

Since the principal subject of this paper is a discussion of the operative procedure, little will be stated relative to the etiology of the deformity, which is at the present time obscure. Many theories have been advanced from time to time relative to its causation, but all are found wanting in making an etiologic study involving a large number of cases. All observers, we believe, are in accord with the opinion that hereditary influences are important factors in the etiology.

In a study of more than 2,000 cases, we have come to the conclusion that there is an abnormal condition present in the germ plasm of one or both parents that inhibits union of the tissues in embryonal life until it is too late for normal union to take place, and, as a result of the inhibition, we observe all of the different types of cleft palate and harelip.

As evidence in support of the theory, we would cite many cases that we see in which Nature, in attempting to close the maxillary fissure, has succeeded up to a certain point, when, it would seem, normal development has ceased, or at least has been impeded in its progress. Children are frequently seen whose lips indicate that the closure of the lip fissure has been accomplished at a period in embryonal life much later than the normal time for such closure, and a definite scar has resulted which in every way seems identical with a postoperative scar of harelip. (Fig. 1.) It would seem that these prenatal scars are definitely associated with the deformity, for we see many of these cases in which the prenatal scar is in the palate and the lip has failed to unite. Again, the prenatal scar is on the lip and the maxillary fissure is open. Still further, there may

*Read before the Section on Maxillofacial Surgery and Surgical Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

*This paper and the papers of Drs. Logan, Moorehead and Brophy make up a symposium on "Surgery of Cleft Palate and Cleft Lip." The discussion appears on page 1112.

be complete closure of both palate and lip, with the prenatal scar present.

We have also seen a number of cases in which one parent had the prenatal scar on the lip and the offspring had cleft palate and harelip. Some of these prenatal scars are as imperfect as the scars from a lip operated on with poor results. On close observation, one can see that Nature has been the surgeon. No operation has ever been performed but Nature has attempted to make a union after the time normal union should have occurred. It is thought by some writers on the subject that the deformity is endemic; that certain localities seem to predispose to this condition. Many operators are agreed that certain localities furnish more of these cases than others, but as to whether this is coincident or not, I am uncertain. It has been our observation that the deformity occurs with more frequency in certain nationalities than in others and that in those localities which are settled and populated by these nationalities, the deformity is more prevalent. With our present knowledge of the etiology of cleft palate and harelip, we are unable to associate climatic conditions or geographic locations as predisposing factors in their causation.

Reliable information as to the proportion of children born with the deformity as compared with normal children is wanting. Several series of statistics have been compiled from obstetric clinics, but they are so diversified as to the results that they are of little value.

Fröebelius,[1] in 1865, published a report based on the number of congenital clefts of the lip and palate found in 180,000 children admitted to the St. Petersburg Foundlings Hospital between the years 1833 and 1863. He estimated that these clefts occurred once in 2,400 births. These figures have been generally accepted, and consequently quoted from time to time.

Davis, in 28,085 deliveries, found twenty-four clefts, or one in 1,200. I found five clefts in an examination of 10,000 skulls, or approximately one in 2,000. So these figures vary, depending on the opportunities and conditions under which such statistics are complied. Statistics are of little importance other than that of general interest as compared with the large problem as to how these unfortunate individuals may be treated so as to improve their physical condition.

In cases in which both the lip and palate are involved, there are always two fundamental objects to be considered and desired: 1. The correction of the deformity so that the facial lines are located in their normal position. If this is accomplished, the postoperative defects will be reduced to the minimum. 2. The establishment of normal function. Normal function in these cases can be established only when the muscles of the soft palate have been placed in their normal relations. When this is done, the palate will be of normal length and flexibility.

The closer we can approach these two objects, the more successful will be the operations for cleft palate and harelip. After all, the principal excuse for these operations is the attainment of these two objects.

The question now arises: If we are to attain to the greatest degree the fundamental purpose of the operation, at what time in the life of the child is it best to proceed, and how shall the operation be performed? In order to

1. Davis, J. S.: Incidence of Congenital Cleft of the Lip and Palate, Ann. Surg., 80: 363 (Sept.) 1924.

comprehend the requirements of an operation to locate the tissues in normal position in these cases of cleft palate and harelip, it is quite essential that each case be studied and analyzed for the purpose of ascertaining the extent of deviation from the normal. In every case in which the cleft extends through the maxillae from the anterior to, and including, the posterior portion, the whole osseous structure, including the malar bones, has deviated from the normal position in varying proportions, according to the width of the cleft.

Brophy[2] called attention to the displacement of the facial bones in a comprehensive paper in 1923, read before the section on oral surgery of the American Dental Association. In cases of complete cleft palate, not only are the facial bones deviated from the normal, but the proximal surfaces of the maxillary bones are elevated as well, which results in the vault of the arch being much higher. As a consequence of the deviation, the horizontal surface of the maxillary bones are canted at varying angles.

Recognizing the deviation from the normal of all of these osseous tissues, the first step, then, in the operative procedure should be to locate those tissues in their normal positions. When sufficient pressure is applied to the malar processes on either side to reduce the cleft, the proximal surfaces of the maxillae are lowered, and the malar and maxillary bones assume their normal positions and relations. This is the first step in the operative procedure, and one that must be accomplished, if all is to be done for the patient that might well be expected under our present knowledge of the deformity. If the malar processes are not moved into their normal position, the results will be that they will act as a fulcrum on which pressure is exerted, which will move the tuberosities of the maxillae outward when an attempt is made to move only the anterior alveolar processes together. This procedure, then, will result in a shortening of the palate. As a consequence, it will not have normal function, and thus the second object of the operative procedure stated above will be defeated.

In our clinics at the University of Michigan we have, from time to time, tried many of the different methods that have been brought forward for the closure of the osseous portion in cleft palate and have followed in detail the Brophy[3] operation for the past several years. This operation is described so beautifully in Dr. Brophy's book on cleft lip and palate that it does not seem justifiable to make it a part of this discussion. Suffice to say that, in the light of our present knowledge of the subject, we believe this to be the only scientific operation for bringing the osseous portions into their normal positions, and we would commend this chapter of Brophy's book to those men who are attempting operations on these unfortunate children without sufficient background in the fundamental principles.

After all that has been written on this subject relative to the age of choice for the different operations, there is still a wide diversity of opinion and lack of knowledge as to this point. Our observations from our own clinics, in

2. Brophy, T. W.: Bone Surgery Essential in the Treatment of Complete Cleft Palate, J.A.D.A., 10: 3 (Jan.) 1923.

3. Brophy, T. W.: Cleft Lip and Palate, New York, P. Blakiston's Son & Company, 1923, p. 163.

which between 350 and 400 patients a year are operated on, confirms the

Fig. 1.—Results of late closure of lip fissure in embryonal life.

opinion that the first operation, in which only the osseous portions are reduced to normal position, should be performed between thirty days and three months

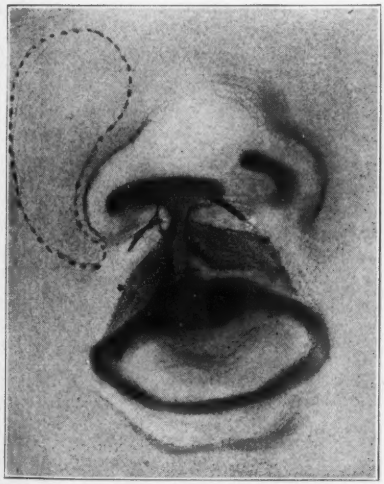

Fig. 2.—First step in harelip operation.

after birth. At this time, the bone salts are not densely deposited, and much of the molding can be accomplished by the thumb and fingers. At thirty days of age, the child can usually withstand the operation with the minimum amount of shock. This operation accomplishes five important points: 1. It straightens up the nose, which is deflected to one side. 2. It brings the alveolar process

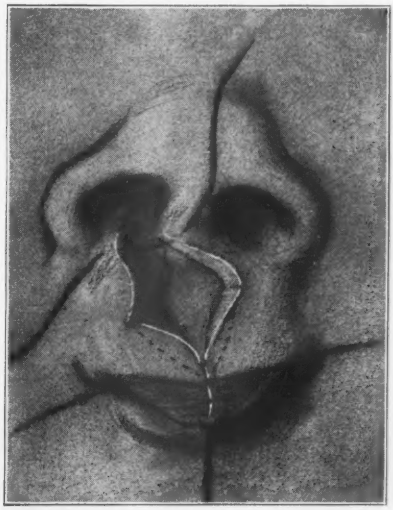

Fig. 3.—Operative procedure before approximation.

into normal position. 3. It narrows the posterior cleft, making for a more simple operation when the time arrives to close the cleft of the soft palate, and enables the operator to obtain normal length of the palate. 4. On account of the alveolar process being closed, there is always relaxation of the lip tissue for the operation on the lip. 5. After closure of the anterior alveolar process, the child will take nourishment more nearly normally.

The second operation, that of closing the lip, should be undertaken just as soon after the first operation as the recovery of the child will permit. We usually wait ten days or two weeks and then proceed to close the lip. The lip operation is an important part of the operative procedure if the tissues are to be restored to their normal position. The first step in the operation of the single harelip is to make an incision underneath the nostril on the affected side and raise up the muscular tissue of the lip and cheek from the periosteum of the maxillae. (Fig. 2.) After the incision is made down to the bone, this tissue can easily be separated by blunt dissection with a piece of gauze forced along the bone with the finger.

After the muscular tissue is sufficiently freed from the maxillae, which can roughly be estimated as covering an area 3 cm. in diameter, the next step is to prepare the two sides of the cleft for the approximation. By the use of graduated calipers, measurements are made of the normal side from the lowest point of the nostril where it joins the nasal septum to the edge of the vermilion border immediately beneath this point. Here a dot is made with methylene blue by puncturing with a hypodermic needle. This shows what the normal length of the lip should be. The calipers are then carried to the affected side and the same measurements are used from the junction of the ala and vermilion border to a point where it reaches the vermilion border below, and another dot is made in the tissues. (Fig. 2.)

The junction of the ala and vermilion border above will eventually be carried over to the nasal septum so that our distances between each ala and vermilion border will be the same, the

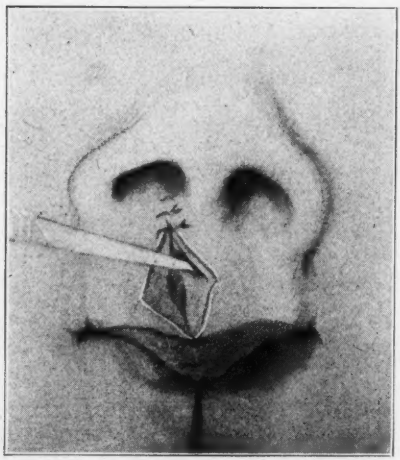

Fig. 4.—Insertion of knife to relieve tension on skin portion.

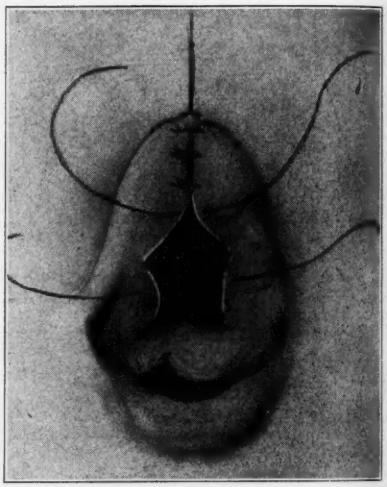

Fig. 5.—Approximation.

operator being thus enabled to make a straight lip. An incision is then started at the inner angle of the nostril and carried through the skin and mucous membrane, the incision being directed toward the first dot made at the junction of the skin and vermilion border. This incision should be carried half way through the length of the lip and, at this point, should be about 2 mm. from the vermilion border that is misplaced. This flap is then turned down and the incision continued on the flap in a semi-circular direction until the vermilion border of the flap is reached. The ends of the vermilion border can then be cut off and discarded. The opposite side is treated the same, retraction sutures are placed through the ends of the vermilion border and the lip is ready for approximation. (Fig. 3.) The tension on the skin portion may be relieved by inserting a knife underneath the skin and elevating it from the muscular portion of the lip. (Fig. 4.) The edges of the lingual surface are approximated and sutured. (Figs. 5 and 6.)

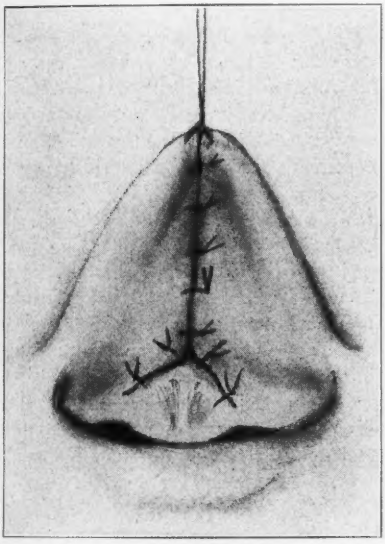

Fig. 6.—Suturing.

For years, one of our greatest disappointments in harelip work has been our constant failure to obtain a normal nostril. Unless the cutaneous lining of the ala is elevated and rotated toward the midline, the nostril has a tendency to become flattened. This lining is deviated as a result of the deformity, and when the tissues are brought into their normal relation, the cutaneous lining of the ala acts in the same manner as an adhesion and tends to pull the nostril down and flatten it.

Fig. 7.—Horsehair suture.

I wish to give full credit to Vilray P. Blair for demonstrating a method by which this postoperative deformity

may be obviated. The cutaneous lining of the ala is elevated and slid toward the nasal septum, and is attached to the upper wall of the nose by a mattress suture. Since we have used this technic for forming the nostrils, it has given us more satisfaction than any other factor connected with the operative procedure in harelips. In harelip and cleft palate work, we have found no suture material that has been so satisfactory in our hands as a good grade of horsehair. The tissues act kindly toward this material; it does not soften, and we have found it sufficiently strong for the purpose. (Fig. 7.) After the approximation of the tissues has been made, we have found the Logan harelip bow very valuable in holding the united lip in quiet contact. (Fig. 8.) The use of this bow has two distinct advantages: (1) it prevents movement of the lip when the child is crying or taking food, and (2) its use permits the wound to be uncovered and in sight at all times, thus enabling the nurse to keep it clean and dry, which are important factors in the process of repair.

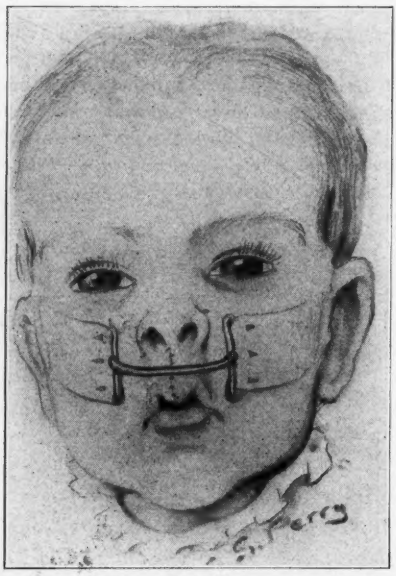

Fig. 8.—Case showing use of Logan harelip bow.

The operative procedure in the double or bilateral cleft lip is similar to that employed in the single cleft lip in ob-

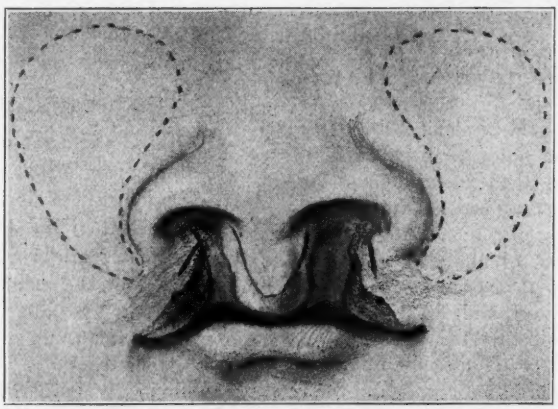

Fig. 9.—Operative procedure in double cleft lip.

taining the measurements and in making the incisions. (Fig. 9.) The principle involved in these cases is to form normal

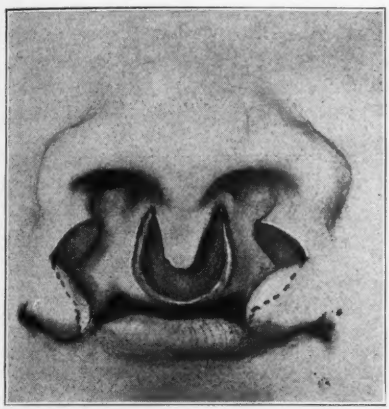

Fig. 10.—Double cleft lip. The displaced vermilion border of the problabium is incised through the labial to lingual, the lingual mucous membrane being left intact.

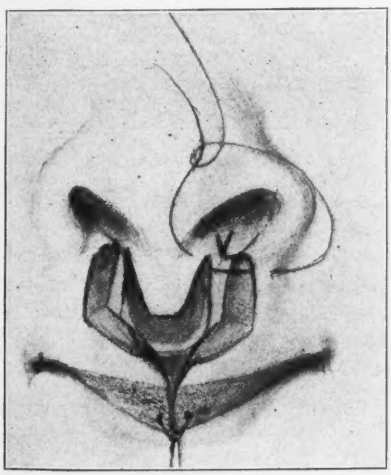

Fig. 11.—Double cleft lip. The skin surface is pared to a conical shape with the apex at the lower border.

anterior nares and unite the lateral walls of the cleft to the prolabium. In these cases, it has been our experience that there is greater danger in getting the lip too long than there is in having it too short. The displaced vermilion border of the prolabium is incised through from labial to lingual, the lingual mucous membrane being left intact,

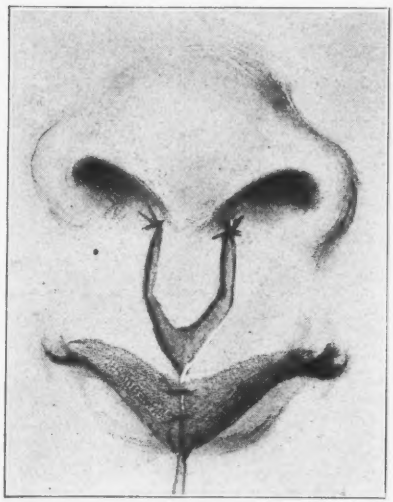

Fig. 12.—Approximation of edges at lateral wall of cleft lip to edges of prolabium.

(Fig. 10.) and the vermilion border of the prolabium becoming a part of the mucous lining of the finished lip. The skin surface is then pared to a conical shape with the apex at the lower border (Fig. 11.) The edges at the lateral wall of the cleft lip are then approximated to the edges of the prolabium. (Fig. 12.) The lower portion of the lateral walls are approximated to each other (Fig. 13) and the mucous membrane of the prolabium, including the vermilion

border, which has now become a part of the mucous lining, is sutured to the mucous membrane of the lateral walls. (Fig. 14.) With this technic, there is no possibility of the mucous membrane uniting with any fresh surfaces of the mucous lining of the alveolar process and later causing adhesions; which results in a postoperative deformity in that the finished lip is not flexible.

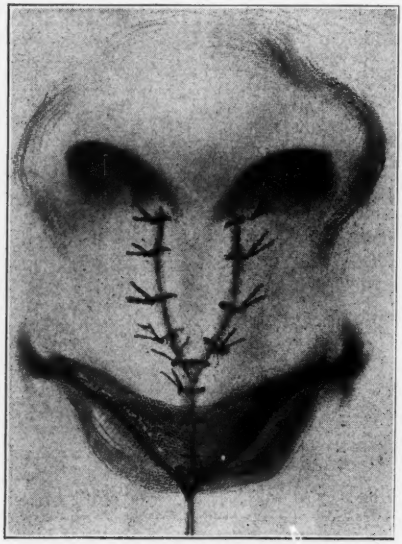

Fig. 13.—Approximation of lower portion of lateral walls.

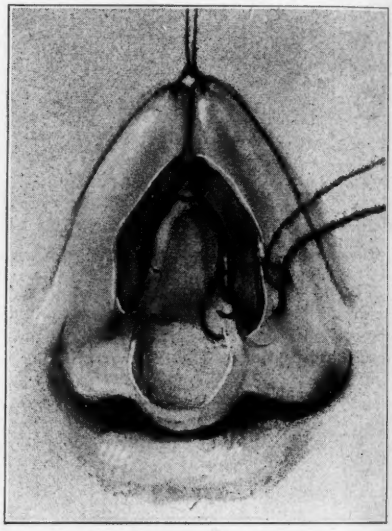

Fig. 14.—Mucous membrane of prolabium, including vermilion border, sutured to mucous membrane of lateral walls.

We are now removing the sutures in all of our lip operations on the fifth day. (Fig. 15.) We have felt that our results in reducing the scar to a minimum are enhanced in taking the stitches out at this time.

After the repair of the lip is complete, the next step in the operative procedure is that of closing the soft palate, including such portion of the hard palate as has not been united by the first operation of closing the anterior portion. (Fig. 16.) This operation should be completed before the habits of speech become fixed. It has been our experience that these children learn to talk very slowly. Theoretically, 20 months is the proper age for performing this operation. However, we depend on the mucoperiosteum for our tissue and closing the remaining portion of the hard palate, and experience has shown to us that, at from 30 months to 3 years, there is more abundant tissue and of better quality in the average case than at 20 months.

We find that it is difficult to disseminate the knowledge of the importance of delaying this operation until sufficient tissue is developed so that a

reasonable hope for success may be assumed. Every year, we are operating on children in whom previous attempts have been made to close the soft palate at from 10 days to 3 months of age, with complete failure as the end result. Not only has the palate failed to unite, but, as a further untoward result of the operation, much cicatricial tissue has formed, with little or no blood supply; which always greatly handicaps subsequent attempts to make a functional palate.

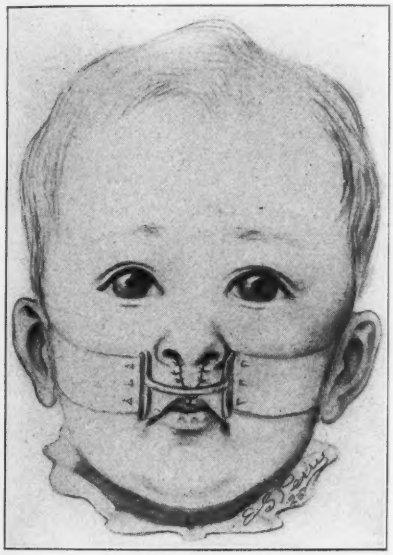

Fig. 15.—Logan lip bow.

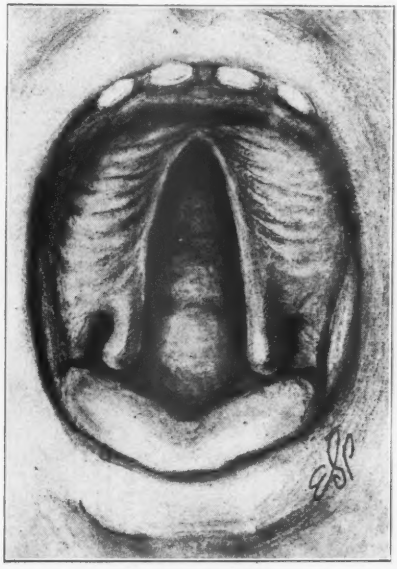

Fig. 16.—Cleft palate.

If nothing more is accomplished by the publication of these papers on this subject than the standardization of a reasonable age for these operations, much will be done for the future welfare of these patients. In the operation for the closure of the soft palate with a varying involvement of the hard palate, one of the most discouraging features that all operators are confronted with is the failure of complete closure. In many cases, a postoperative opening, usually at the junction of the hard and soft palate, occurs, varying from 1 mm. to 1 cm. or more in diameter. These are sometimes very difficult to close in a subsequent operation. These openings usually result from one of three causes: (1) infection, (2) lack of blood supply and (3) too much tension on the mucoperiosteal flaps. We wish to dwell at some length on the last of these factors and to offer some practical suggestions to overcome it.

In the first place, let us return to the first operation of bringing the alveolar processes into their normal relation, the Brophy operation. Unless this is ac-

complished, there will be such a wide spreading of the tuberosities that it will be next to impossible to adjust the soft parts into normal position without greatly shortening the palate and producing an undue amount of stretching of the mucoperiosteal flaps. Proper adjustments of the osseous portion of the

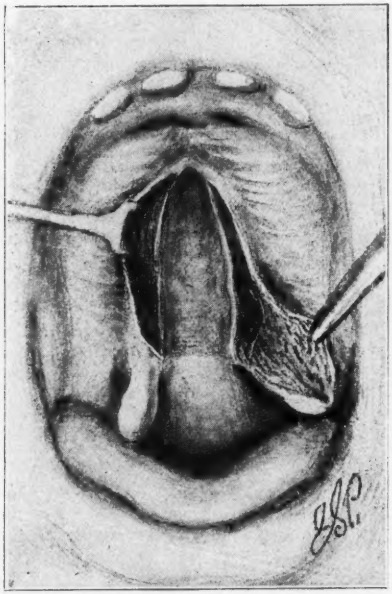

Fig. 17.—Cleft palate operation. The median surface of the palatopharyngeal muscle is scarified by splitting the mucous membrane covering it.

palate in the first operation will accomplish more in the prevention of postoperative openings in this operation than anything with which I am familiar.

During the past eighteen years in our clinics, we have used many of the different devices and methods for relieving the tension of the sutures of the mucoperiosteal flaps, most of them with indifferent results. We have used the lead and silver plates with, first, four silver wires running from one plate to the other on the nasal surface; then the plates, with two wires, and then with only one wire. These plates were first adjusted anterior to the azygos uvulae, then at the base of the uvulae, and then distal to the uvulae, splinting the mus-

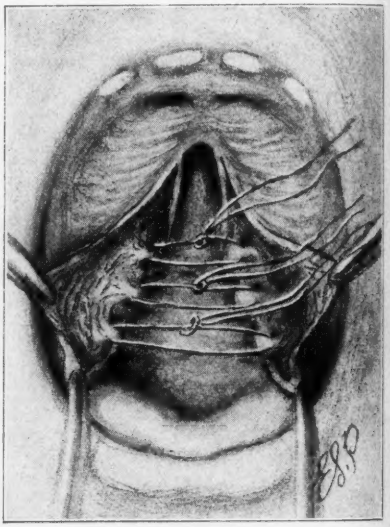

Fig. 18.—Chronic sutures.

culature of the palate. Our observations have been that, if the wires and plates were adjusted with sufficient pressure to act as a splint, the tissues would not tolerate them and they would cut into the tissues until the undue pressure was relieved. If they were not adjusted sufficiently to act as a splint, they were of no avail and only provided a means for the collection of food débris. After several years of experimentation and observation, we discarded the plates entirely and provided our

relaxation of the palatal tissues by making a horizontal incision through the mucous membrane distal to the tuberosity, and by blunt dissection separating the tissues at that point, and packing with iodoform gauze, leaving the gauze in this position for four days. In our hands, this offered a greater degree of success than we had in the use of the plates and wire. This incision is made distal and lateral to the blood supply to the palate, and the cicatricial tissue that formed at the point does not interfere with function.

This also had its objections. The gauze dressings would constantly be working out and they too were unclean, although not a single case have we on record where infection occurred around the gauze dressing.

The technic that has given us the greatest satisfaction in the closure of the soft palate is one we have been using exclusively during the past year. In this, we are confining the technic of the operation to the principle used in general surgery in the closure of any wound in which muscular tissue is involved.

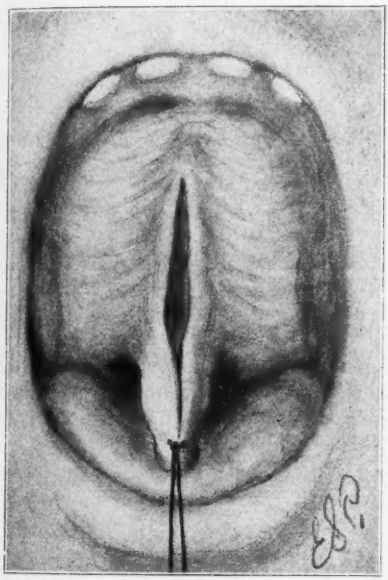

Fig. 19.—Approximation of the whole palate. The mucoperiosteal flaps are in a position where there will be no tension on the coaptation sutures.

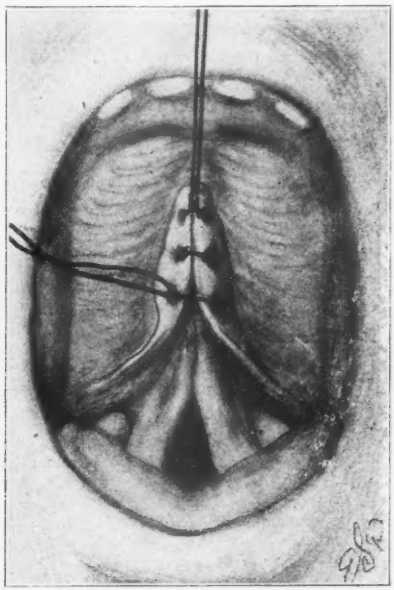

Fig. 20.—Suturing the uvula.

Let us for a moment consider the anatomy of the field of our operation. When this operation is completed, there is a tremendous muscle pull on the coaptation sutures. Yet many of us have depended on the frail mucoperiosteal tissue plus splints of varying kinds to keep the palate intact. When the general surgeon is ready to suture the

abdomen after an operation, after closing the peritoneum he first approximates the muscular tissues with heavy chromic or catgut suture before he closes the skin incision. He would not depend on the skin to hold the wound. Yet that is just what many of us are doing in the cleft palate work. We have hoped that our frail flaps would

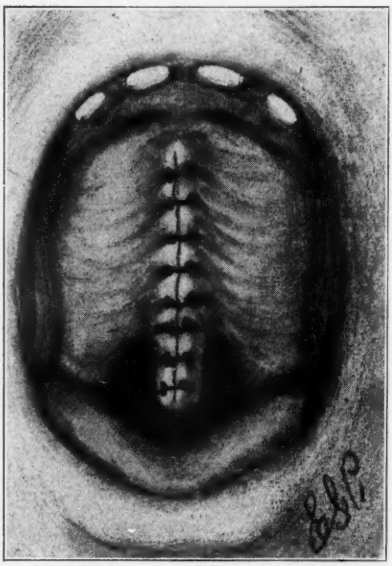

Fig. 21.—Cleft sutured.

hold against the muscle strain of deglutition, crying, etc.

The technic we are now using consists of elevating the mucoperiosteum from the hard palate by means of suitable periosteotomes and cutting the palatal aponeurosis, throwing our two flaps together. The median surface of the palatopharyngeus muscle on either side is scarified by merely splitting the mucous membrane covering it. (Fig. 17.) The half of the azygos uvulae on either side is treated in the same way, with removal of the mucous membrane

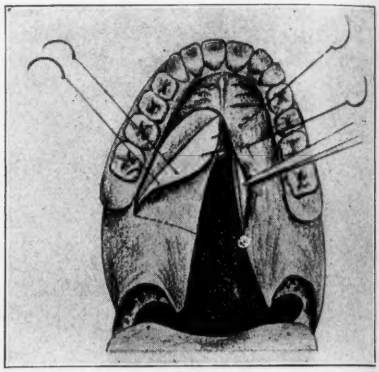

Fig. 22.—Mucoperiosteal flap raised up from bone and inverted under margin of flap from opposite side and sutured.

down to its base. Our next step is to approximate the muscular tissue of the palate. This is done by burying a chromic suture No. 0, just in front of

Fig. 23.—Coaptation of two flaps with interrupter suture.

the base of the uvulae, two at the base and one at the junction of the palatopharyngeus muscle and the base of the

uvulae. (Fig. 18.) This procedure approximates the whole palate and places the mucoperiosteal flaps in a position where there will be no tension whatever on the coaptation sutures. (Fig. 19.) We use mattress sutures of horsehair anterior to the uvulae and interrupted sutures of horsehair posterior to it in suturing the flaps. (Figs. 20-21.) Since using this technic, our results have been much superior to any we have obtained. We do not claim originality in this operation, but since we have been using it, we are filled with wonder that this principle of surgery has not been used more than it has been in cleft palate operations. From our experience with this technic, covering more than eighty cases, we submit it as a sound and scientific procedure and one that will eliminate postoperative opening in the palate in many cases.

In extremely wide clefts or for large postoperative openings in the palate, we have found what we have elected to call a modified Lane technic a very satisfactory procedure.

The mucoperiosteum[4] is raised up from the hard palate beginning at the outer margin of the cleft on the side unattached to the vomer. The aponeurosis of the soft palate is cut away from the palatal process of the maxilla on this side only; which results in the formation of a single flap running from the anterior part of the cleft to, and including, the palatopharyngeus muscle.

On the opposite side of the hard palate, an inverted flap is formed by a longitudinal incision beginning at the junction of the hard and soft palates 1 mm. lingually from the gingivolingual margin of the teeth. By the use of a curved periosteotome, the mucoperiosteal flap is raised up from the bone and inverted under the margin of the flap from the opposite side (Fig. 22) and sutured. A mattress suture seems to be ideal for this purpose. This acts as a stay suture. Coaptation of the two flaps is made with an interrupted suture. (Fig. 23.) This procedure has proved highly successful in those cases in which operation has previously been performed with a varying amount of cicatricial tissue involved, and those in which we were sure that there was not sufficient palatal tissue present to insure a successful operation by our regular methods.

4. Greenthal, R. M., and Lyons, C. J.: Preoperative Management of Infants with Harelip and Cleft Palate, and a Further Discussion of the Deformity, Dent. Cosmos, 64: 396 (April) 1922.

CONCLUSION

There are certain principles in the surgical procedure in cleft palate and harelip that should be standardized. Each operator must work out his own technic to carry out those principles. The technic that is successful in one man's hands may prove a failure in another's. Each case, too, presents problems of its own, so that a definite technic in every case is not possible. Our great ambition in the operative procedure should be to attain the two goals of normal appearance and normal function.

DISCUSSION

Truman W. Brophy, Chicago, Ill.: I am glad that Dr. Lyons has recognized the error in the definitions that appear in nearly all of the old textbooks and some modern ones, setting forth that cleft palate is the result of arrested development of the tissues. On the contrary, he declares that a cleft palate is due to misplacements of well-developed parts, and with this I agree. As to the etiology of the condition, I believe there are three factors that account for it: heredity, the action of the tongue and the action of

the mandible. We have abundant evidence of the influence of heredity in this condition. Statistics in my own practice and the practice of others establish this beyond any doubt. In early embryonal life, the tongue is five or six times thicker than at birth, sometimes nearly filling the nasal cavity. Its very position prevents union of the separated parts, and besides it exerts pressure outward and upward upon the unossified bones. The mandible exerts its force upward against the lingual surfaces of the inclined planes of the palatal plates of the maxillary and palate bones, owing to traction of the muscles of mastication, which become active at the third month, thus widening the separation and eventually shortening the palate. The force thus exerted is a powerful factor in spreading the arch and in misplacing upward the horizontal plates of the maxillary and palate bones, sometimes to an angle of 70 degrees. These three factors are established. Other claims, such as prenatal impressions, are without proper foundation. Dr. Lyons says that at the age of 30 days, the child is usually able to withstand the shock of operation, a fact established by the best authorities of our country. He has made the following assertions regarding this first operation to unite the bones: 1. It straightens the nose, which is deflected to one side. 2. It brings the alveolar process into normal position. 3. It narrows the posterior cleft, this making for a more simple operation when the time arrives to close the cleft of the soft palate, and enables the operator to obtain normal length of the palate. 4. On account of the alveolar process being closed, there is always relaxation of the lip tissue for the operation on the lip. 5. After closure of the anterior alveolar process, the child will take nourishment more nearly normally. In all this, I concur. Dr. Lyons performs the lip operation in from ten dayes to two weeks after the bone operation. I would suggest a greater length of time between these operations. I usually wait from four to six weeks, to give the child more time for recuperation; but, in view of the fact that, in his clinic, 200 operations have been made without a death, it would seem there could be no objection to his choice of time for the lip operation. All I have to say regarding the lip operation is that the bones should be first put in correct position and united before the lip operation is attempted; and that the taking of large crescent shaped pieces of tissue from each edge of the fissure results in irreparable loss of tissue and shortens the lip from angle to angle, preventing normal form or function. The calipers are very successfully used by some, and there can be no objection to them. I agree with Dr. Lyons that the nose is often badly treated and as a consequence the nose deformity remains after it is announced that everything has been finished. But the deformity of the nostril and deflected nose itself is very common when the bones have not been correctly united. The broad, flattened nostril may generally be corrected at the time of the lip operation by pursuing the plan Dr. Lyon has presented. The Logan bow has been of great advantage to all operators who have used it. It is simple in construction and application and accomplishes all that we desire in holding the newly approximated edges of the lip in correct position; and the lip surfaces are left free for inspection and for cleansing. Some years ago, I was in the habit of operating on the soft palate in children at the age of about 14 months, but as time passed, I corrected my methods by delaying this operation until just before the child began to talk, which will average from 18 to 22 months. The tissues are thicker and stronger, and our success in placing and retaining the parts in apposition and securing a good union is more nearly assured. The technic of the soft palate operation as given in this paper has in it some new features, and those who expect to make use of it should study carefully the illustrations in this article. It could not be other than gratifying to me to listen to a paper which presents in such a terse and well written manner this great subject and in which are endorsed some of the methods I have advocated. These procedures have stood the test of forty-one years of time and some thousands of operations at my own hands; and I am happy to know of their adoption in the clinic presided over by Dr. Lyons, where, with their 350 to 400 patients annually, they have a most unusual opportunity to prove the efficiency of the methods employed. I feel that I express the feeling of many surgeons when I congratulate Dr. Lyons on his magnificent achievements in his work in this clinic, and in the preparation of this paper.

SURGERY OF CLEFT PALATE AND CLEFT LIP*

By WILLIAM H. G. LOGAN, M.D., D.D.S., F.A.C.S., F.A.C.D., Chicago, Illinois

A REPORT on the surgery of cleft palate and cleft lip, with the query as to when surgical correction should be undertaken, is indeed wise. Since the decision is so often varied, it is justifiable to ask those of large experience in this field to state at what time surgical interference should occur in order to assure the best results in accordance with the findings in the cases that have come under their observation and management. This I shall endeavor to do; but to avoid a lengthy discussion and confine myself to the time limit specified, only a declaration of the principles involved will be made, followed by a brief substantiating discussion.

An infant born with cleft of the lip (complete or incomplete, single or double), but having a normal maxillary ridge which may, or may not, be complicated with cleft to any degree of the soft and hard palate, posterior to the normal anterior maxillary ridge, should not have the lip deformity corrected, as a general rule, until it has ceased to nurse (provided it is able to nurse), for the reason that to operate previously to this time would probably result in causing lactation to cease, entailing artificial feeding during the critical days following the operation. In those instances in which the surgeon is positive that the mother's milk can be maintained throughout the entire period of postoperative treatment, the lip may be corrected any time after birth that the physical condition of the child permits, even during the first few days of life. In cases in which there is a normal maxillary ridge and the infant is not receiving its nourishment by nursing, the operation on the lip need only be postponed until a proven formula has been found and a satisfactory condition is established, and there is an appropriate daily gain in weight.

We are now confronted with the question as to the time and sequence of operations for cleft of lip (without regard to whether it is complete or incomplete, single or double), when a child is born with a cleft of the lip complicated with complete cleft of the hard and soft palate and the maxillary ridge.

I believe that the best results will be more uniformly secured in the management of cleft of the lip complicated with cleft of the palate and maxillary ridge, if the first operation deals with the closing of the cleft through the maxillary ridge and a reduction in the width of the cleft throughout the hard palate, when indicated, and in accordance with the technic hereinafter described; to be followed by a delay of from three to six weeks before the operation for closure of the cleft of the lip. The operation for reduction of the width of the cleft throughout the hard palate and its closure through the maxillary ridge should be performed as soon as the infant has been placed on a proven formula, has regained its birth weight, and is making satisfactory daily progress physically. These infants, as

*Read before the Section on Maxillofacial Surgery and Surgical Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

a rule, can be brought to a condition favorable for operation between the third and twelfth weeks of life, when the feeding is carried on under the direction of a specialist. When the operator is permitted to set the time arbitrarily for the first operation, a date between the fourth and twelfth week is selected; and this statement refers to the management of complete single clefts of the hard palate and maxillary ridge, or those complicated with protruding premaxillary bones.

As indicated, the operation to be performed first when we have a cleft of the lip of any degree complicated with complete cleft of the soft and hard palate and maxillary ridge, with or without protruding premaxillary bones, is closure of the cleft through the maxillary ridge, and, if advisable, the anterior third of the hard palate, with a definite narrowing of the distance between the borders of the cleft straight in from the tuberosities, if the cleft at this point is wide.

REASONS FOR THE FOREGOING CONCLUSIONS

1. By not operating on the lip when there is complete cleft of the maxillary ridge, and hard and soft palate, until the approximation of the maxillary ridge, and, when indicated, the separated bones in their anterior one-third, has been accomplished, one is able to construct a more nearly normal floor of the nasal fossa on the afflicted side.

2. Since the nose of a patient with a single cleft lip and complete cleft palate is not, as a rule, in the median line and can more positively be brought into its normal position and retained there by bending the long side of the bone toward the fissure, at the same time pressing it backward to overcome the usual labial prominence that practically always obtains, one can, by operating during the period when the bones will bend, carry the center of the nose into the median line and there fix it.

3. A more harmonious maxillary ridge outline and bony facial support can be secured when the separate bones forming the upper jaw are placed in their proper position in the first week of life, but great caution must be exercised not to carry the protruding bone on the long side too far inward, with the single thought of making great harmony of outline of the maxillary ridge; for to do so often results in bringing the upper anterior teeth inside the lower teeth, and gives to the upper lip a depressed appearance that can be avoided when the proper technic is employed in this operation.

4. By operating in early infancy, the jaw and facial development will be more symmetrical than would be the case if these bones, soft tissue and muscle were not brought into full functional activity until some years after birth.

The contention has justly been made by advocates of the early operation for correction of the cleft palate that if the child is to be expected to appear and speak normally, the abnormality should be overcome before the infant begins to speak. If we form for the child a normal functioning palate and lip before it begins to articulate words, we can, with greater justification, expect it to speak as do children who are born with these parts normal.

The sequence and relative dates of the necessary subsequent operations, after closing the cleft in the maxillary ridge and the anterior part of the palate, are as follows: If it is not found to be advisable to close the lip at the time of

operation for closure of the cleft in the maxillary ridge (and in all extreme cases, it is not advisable) in from three to six weeks after the maxillary ridge is closed, the cleft lip operation should be performed, provided the physical condition warrants. The closure of the soft palate should be postponed until the child is from 18 to 24 months of age, or about the time when the child begins to speak. I believe that operation for closure of the soft palate, without regard to whether it involves only the uvula, or the soft palate, or extends through the hard palate to the anterior maxillary ridge, should not be performed, in most instances, before 16 months, and the results will be more nearly uniform when performed between the eighteenth and twenty-fourth months.

An earnest plea is made that the premedical and postmedical treatment of these infants be supervised by a pediatrician. If the surgeon makes it a rule never to operate on such a patient until it is pronounced physically fit by a specialist, his percentage of mortalities will be exceedingly low. My records show a more serious reaction and higher percentage of fatalities following the lip than palate operations.

GENERAL STATEMENTS AND SUMMARY

To bring the separated bones of a complete cleft of the hard palate and maxillary ridge, at their anterior one fourth or one third, into apposition, and, when necessary, reduce the distance between the borders of the cleft straight in from the tuberosities to a degree that the case demands, and there retain them until union occurs, calls for the application of force at given points and on fixed lines, and retention with materials that will withstand the strain necessary to hold these separated bones in contact without undue irritation for four weeks. The procedure and materials as advocated for the Brophy operation on the hard palate are recommended because they give a higher percentage of success than any other technic with which I am acquainted. I have been lead to believe, during the past few years, that we should not leave the lead plates in position, when utilized for the closure of the cleft in the hard palate, to the maximum of from six to eight weeks as practiced by some operators.

Although only a single technic has been suggested, I do not contend that other methods will not produce satisfactory results, provided (1) the method followed avoids making incisions that will destroy or reduce the function of the important muscles of the palate; (2) the operative procedure avoids, as far as possible, any unnecessary shortening of the palate; (3) the method adopted results in a reduction of the distance between the borders of the bone cleft directly in from the tuberosities when indicated; (4) when the cleft is complete, the surgical correction establishes the maxillary ridge and the floor of the nasal fossa, at least in its anterior part; and (5) the correction of the cleft in the lip permits it to function relatively normally, and, in appearance and thickness, it is symmetrical with the tissues beneath the nostril on the normal side.

We should be ever mindful that not only the palate, but also the lip, must be given sufficient fullness to meet the lower lip, so that such a patient will be able to say such words as "boy," "Peter," "bat," "papa," "lip" and "back." Unless the maxillary ridge is properly formed so that the teeth may erupt relatively normally, or may there-

after be normally supplied, these patients will be unable enunciate such words as "vain," "vanity," "front," "fast" and "farthest."

If the case is complicated with protruding premaxillary bones, these should never be excised, but retained and placed in position by a submucous bone incision a quarter inch above the junction of the vomer back to the point where the usual resection of bone is made to permit the premaxillary bone to be drawn downward and placed in contact with the lateral portions of the maxilla. The old method results in extreme flattening of the end of the nose. I have found it possible to reduce materially this objectional feature by making the incision in the line indicated; which allows for carrying the premaxillary bone not only downward but also backward, and the placing of the premaxillary ridge not tipped in but sitting relatively normally, and in a majority of cases doing away with any material flattening of the end of the nose.

The employment of equisetene suture material in the lip and palate operations, (when ideal horsehair is not available), and the sealing of the line of incision on the labial aspect of the lip with liquid benzoin evaporated to a syrupy consistency (the benzoin sealing to be removed on the third or fourth day) is recommended, unless the patient is under the care of a nurse, in which instance the wound on the skin surface may be as well treated by the application of a 50 per cent alcoholic solution for the removal of the plastic exudate as it makes its appearance on the skin surface of the wound previous to the crust formations.

The sutures of silver wire, lead plates and silk are removed from the palate on the ninth or tenth day, and we have found it inadvisable, in the majority of cases, to irrigate during this period. We have also discontinued local application of germicides as it is believed to be unnecessary, except in rare instances.

To remove tension from the suture line in cleft of the lip, the application of the Logan traction bow, with tension straps of adhesive plaster to the cheek and face, is again recomended, and unless there is ample tissue to form the nostril, the adjunct of silver or silk sutures, passed through tin foil or the thinnest of lead, is advised in all complicated cases.

CONGENITAL CLEFT LIP AND PALATE: SOME PERSONAL OBSERVATIONS*

By FREDERICK B. MOOREHEAD, M.D., Chicago, Illinois

THE body of experience in this country alone, not discounting or forgetting the wealth of experience in the older European countries, rather definitely illustrates and fixes the principles and technic of the treatment of congenital cleft lip and palate. Von Langenbeck's method of treatment still remains as a standard. Brophy, more than any other American, has enlarged the scope and added to the refinement

*Read before the Section on Maxillofacial Surgery and Surgical Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

of methods. His work is so widely known that it is unnecessary to give any details regarding it.

Fig. 1.—Dissections, to relieve tension and permit molding (illustrated by dotted line).

In general, the problem may be outlined under (a) preoperative management; (b) surgical correction; (c) postoperative management; (d) speech training, and (e) treatment of postoperative defects.

Fig. 2.—Direct view of dissection.

The skilled pediatrician is an essential agent in the management of the baby born with cleft lip and palate. It is first of all a medical problem, and no surgical treatment should be undertaken until the diet has been successfully established and all surgical contraindications have been eliminated. In our

Fig. 3.—Process of molding bones to reduce deformity of arch and nose.

series the items include: (a) enlarged thymus; (b) rickets; (c) latent pyelitis, pyelocystitis, and (d) congenital syphilis.

These by no means cover all the medical problems of the newborn, but they are outstanding findings in our experience. In the matter of feeding, the

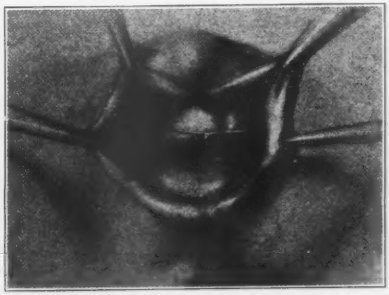

Fig. 4.—Silkworm-gut suture transfixing bone.

finding of a suitable formula not only insures development but also furnishes

a tested diet after operation. Surgical correction may be undertaken as soon as diet is satisfactorily established and the child shows reasonable increase in weight. These conditions are ordinarily met four to six weeks after birth.

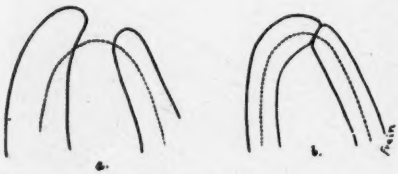

Fig. 5.—Relation between upper and lower arches (*a*) before and (*b*) after correction. The dotted line represents the lower arch.

Feeding may be carried on with a spoon or medicine dropper of suitable size. The nipple should never be used as the pressure exerted in sucking will cause a certain amount of bone separation and, with it, characteristic low

Fig. 6.—Transverse incisions for closure of simple form of single harelip.

flat nostril. Any separation of bone will be reflected in the nostril.

Immediately after operation, the patient is again the direct charge of the pediatrician. The care of the wound is a minor incident, and is most satisfactorily handled by the open method.

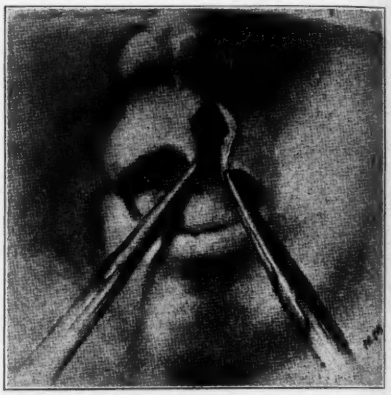

Fig. 7.—Lip held in position for closure.

The usual dressing supported by adhesive strips interferes with wound repair rather than contributes to it.

Fig. 8.—*a*, hard and soft tissues of palate; *b*, mucoperiosteal dissection; *c*, method of splitting soft palate to avoid dividing nasal aponeurosis.

Secretions from the nose, together with the liquid food, keep the dressing constantly wet. A dry wound is always

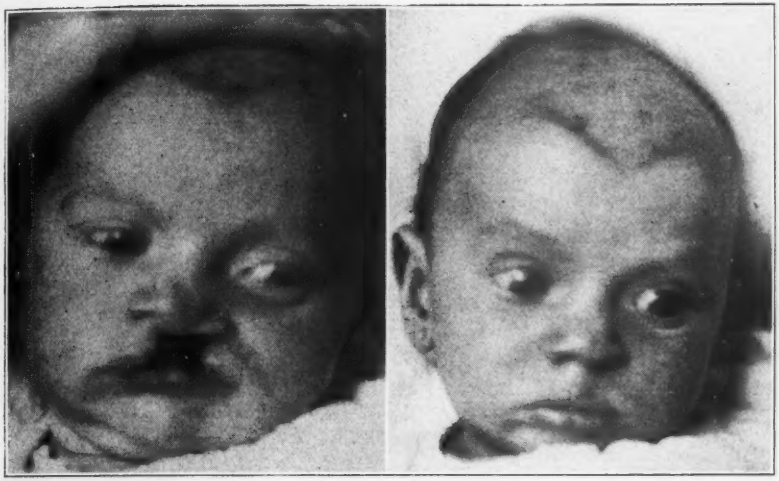

Fig. 9.—Appearance of patient (left) before and (right) after surgical correction. Figures 9-19 illustrate (1) the various types and degrees of unilateral and bilateral cleft lip; (2) molding of bone to close the arch and correct nasal deviation; (3) shaping of the nostril, and (4) closure of the lip. Most of the photographs showing the completed case were taken at the time that the stitches were removed, or a day or two later.

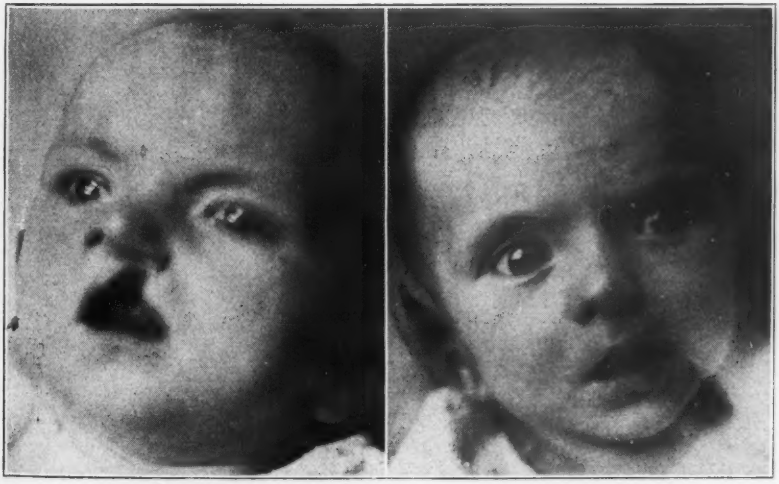

Fig. 10.—Appearance of patient (left) before and (right) after operation.

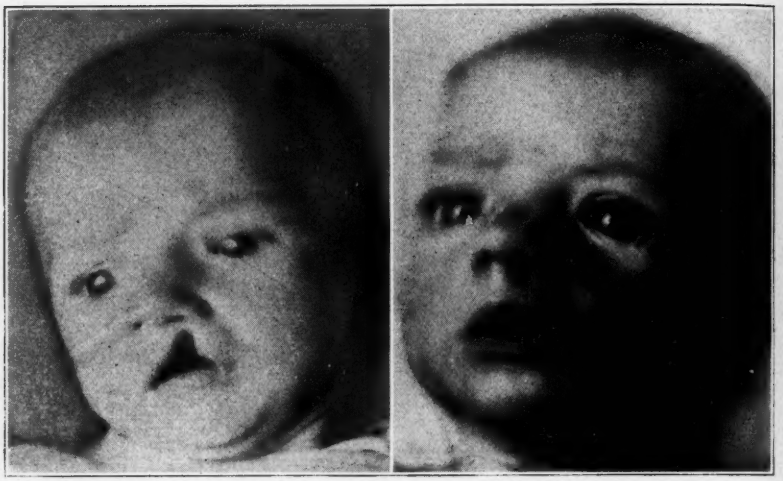

Fig. 11.—Appearance of patient (left) before and (right) after operation.

preferable to a moist wound, apart from the danger of infection. Tension should be relieved by proper and adequate flap preparation, and not by postoperative or even preoperative dressings or devices. Freedom from irritation is paramount, particularly in children. The wound should be care-

Fig. 12.—Appearance of patient (left) before and (right) after operation.

Fig. 13.—Appearance of patient (left) before and (right) after operation.

fully cleansed once or twice daily, sponged with 50 per cent alcohol and dusted with Thiersch powder. This detail may be discontinued with the disappearance of blood and wound secretion. On the fourth day, the removal of sutures should be begun, one or two at a time, strategic sutures being left till the last—seven or eight days after operation.

The anesthetic is of first importance. An electric vaporizer and aspirator are

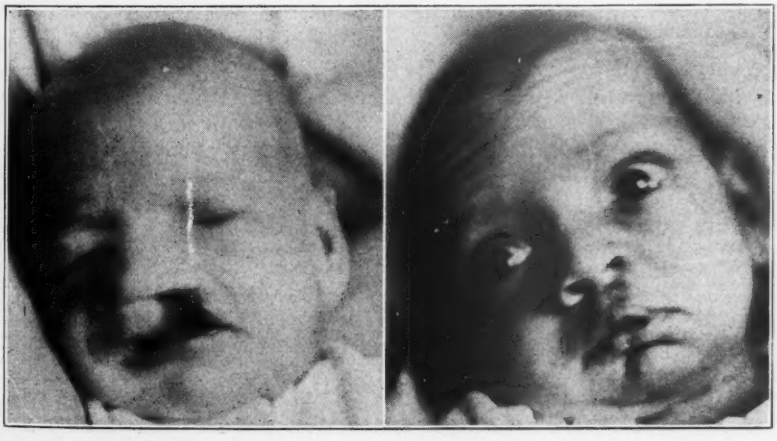

Fig. 14.—Appearance of patient (left) before and (right) after operation.

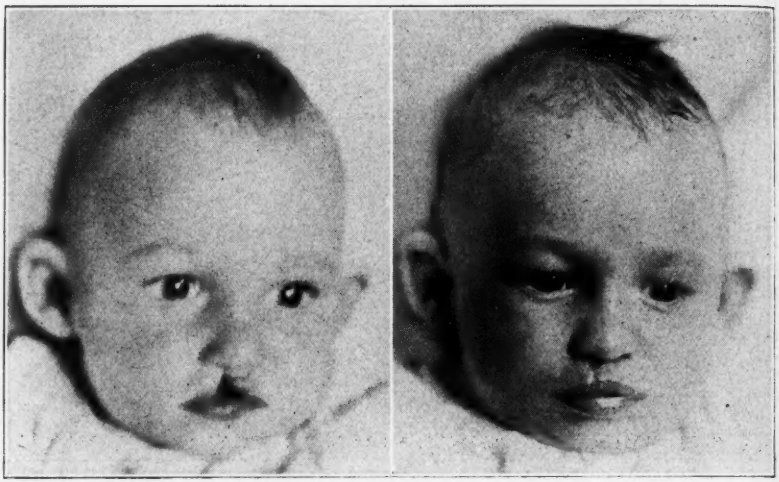

Fig. 15.—Appearance of patient (left) before and (right) after operation.

indispensable. The aspirator keeps the blood out of the throat and reduces the amount swallowed, and its use takes precedence over sponging in point of both time and irritation of the tissues. With the assistance of a skilled anesthetist, the operative period is materially reduced.

While these matters have nothing to do with the operative results from the point of technic, they contribute in a primary way in safeguarding the life of the child and insuring speedy wound repair.

The operative treatment presents a threefold problem, involving the jaw, the nose and the lip, all three being involved in the deformity. No one of the three can be treated independently of the others. Unless a successful bony

Fig. 16.—Appearance of patient (left and center) before and (right) after operation.

orientation is obtained, the arch, the nose and the lip will be defective. In point of importance, the sequence is an obvious one: arch, nose, lip.

1. The Arch.—The first step is complete anatomic restoration, which is accomplished by immediate molding. The lip and cheeks are dissected from the bone (Fig. 1) to a point permitting proper shaping of nose and lip without tension (Fig. 2). A single silkworm gut suture is used to transfix the bones (Fig. 3). If placed carefully the suture does not damage or interfere with the development of the teeth. The bones are molded with a threefold purpose in view: (a) to close the bony cleft; (b) to restore proper relationship between upper and lower arches, and (c) to bring the nose into the median line of the face. When the tip of the nose has been brought into the median line, the septum will be straight, and the nasal passages equal, if the molding is limited to the long segment. By bringing the two jaws together before the cleft is closed, it will be noted that the occlusal relationship of the short segment is practically normal, and that the deviation is confined to the anterior two thirds of the long segment (Fig. 5). It follows, therefore, that the molding of the anterior two thirds of the long segment will bring the two arches into normal occlusion and will reduce the nasal deviation and close the upper arch.

Fig. 17.—Appearance of patient (left) before and (right) after operation.

The occlusal relation is further proved when the deciduous teeth erupt. The linguobuccal relations have been normal in our cases, without disturbing the posterior jaw. It is interesting to note the occlusal relations in bony clefts extending only to the anterior ridge. One often sees a wide cleft in an adult extending to the anterior ridge with

normal occlusion of bicuspids and molars.

Occlusal defects we believe are due to clefts extending through the anterior ridge, and the deformity is measured by the malposition of the anterior two thirds of the long segment. When the long segment is reduced, the cleft is closed, the upper arch properly related to the lower arch, the nose placed in median line and the deviation of the septum corrected. Only when such reduction has been made is a normal nose or lip possible.

2. The Nose.—The correction of the nasal deformity is coincident with correction of the bony arch (Fig 6). The one is contingent on the other. Unless the bony nose is completely reduced, it is not possible to shape the defective nostril. Bone reduction is basic, and when accomplished, the nostril is not a difficult problem. The defective nostril is fashioned after the good one.

3. The Lip.—The lip problem (Figs. 6 and 7) is half solved in steps preceding. The two necessary final points are proper length and relation of skin and mucosa. We have always followed a simple method of shaping the lip. A transverse cut is made midway between the nose and the vermilion border, and a small section of tissue is removed above and below the incision. Artery forceps grasp the lower border, and with a sharp pointed knife, transverse cuts are made along the freshened surface to lengthen the lip to the desired length.

Fig. 18.—Appearance of patient (left) before and (right) after operation.

The second most important item in closing the lip is the placing of the sutures. We prefer the use of a mattress suture introduced from the mucous surface and carried deeply into the muscle, but not into the skin. A substantial

muscle union, we believe, is the most vital item in lip surgery.

The condition of low, flat broad nostril following operation has several etiologic factors: (1) incomplete reduction of the long segment, (2) depression of the short segment, (3) incomplete or imperfect preparation of soft tissues in shaping the nose and the lip, and (4) use of a nipple, sucking of the thumb or finger, or the use of a "pacifier."

The hard palate and lip are closed at the same sitting, and the soft palate at about the twelfth month. Whether the entire cleft is closed at one sitting will depend on the width of the cleft, body of tissue and blood supply. It is frequently advantageous to close the posterior half and the anterior at a later date.

A point of considerable importance in closing the soft palate is the splitting of the tissues at the posterior border of the hard palate instead of dividing the aponeurosis to relieve tension. By splitting the tissues (Fig. 8), the tension is relieved and the whole blood supply retained.

Secondary defects present a different set of problems, no two cases responding to the same type of operation. Secondary defects are due, in the main, to (a) primary operations on babies who have not been properly prepared and whose general condition does not favor wound repair; (b) closing of the palate at too early a date, before the tissues have become sufficiently robust; (c) extensive operations in wide clefts, which destroy the blood supply; (d) operations made by surgeons unfamiliar with this class of surgery.

Fig. 19.—Appearance of patient (left) before and (right) after operation.

The drawings presented illustrate a few of the common defects, and the technic employed in correction.

30 North Michigan Avenue.

CLEFT LIP AND CLEFT PALATE*

By TRUMAN W. BROPHY, M.D., D.D.S., Sc.D., F.A.C.S., F.A.C.D., Chicago, Illinois

CLEFT lip, like cleft palate, is nearly always due to failure of union of well developed parts. This fact is now generally admitted.

It must be remembered that there is enough tissue, *but only* enough, in cleft lip to form a normal lip. Therefore, any sacrifice of tissue, other than that needed to freshen the edges and bring the misplaced tissues into normal relationship is to be condemned. A striking example of unnecessary waste of valuable tissue, resulting in shortening of the lip from angle to angle, is seen in the Rose operation.

There are at least twelve forms of cleft lip, one of which is occasionally seen in the lower lip.

The time to operate depends not so much on whether the cleft of the lip is complete or incomplete, single or double, as on whether it is simple, or complicated by a separation of the bones of the palate and alveolar ridge.

If without the above mentioned complication, and having either a normal palate or a cleft illustrated by Forms 1 to 6 inclusive and Form 15 of my classification, the cleft lip should be operated on preferably at the beginning of the second month if the physical condition of the patient will admit. While I fully realize that the younger the child, the less the shock, I believe it is safer practice to wait until the normal functions of all the organs of the body have been well established.

The deferring of the operation beyond this in case the health of the child is not satisfactory will do no harm.

If the case is complicated by separation of the bones of the palate and alveolar ridge, as shown by Forms 7 to 14 and also Form 16, the lip is not operated on until the bones have been put in proper contact, immobilized and firmly united. The foundation which Nature provided for the lips is formed by the alveolar process, supported by the premaxillary and maxillary bones; hence, the importance of bringing the misplaced bones into correct position, firmly immobilizing them, obtaining union and thus establishing a foundation for the lip which will enable the surgeon to impart to it anatomic perfection. It is a rule that a reliable foundation is essential to all dependable superstructures. The lip is no exception to this rule in cleft lip.

Usually, in single cleft of the lip, if the alveolar process and hard palate are involved, there is a further complication, the nose being diverted from the median line; the deflected vomer attached to only one of the maxillary bones, and one nostril abnormally wide and flattened. This calls for skilful surgery in conjunction with the operation on the lip.

CLEFT PALATE

A cleft palate may be complete or incomplete, single or double, simple or complicated.

*Read before the Section on Maxillofacial Surgery and Surgical Prosthesis at the Seventh International Dental Congress, Philadelphia, Pa., Aug. 24, 1926.

There are sixteen forms of cleft palate, according to my classification, six of which may involve the muscles of the soft palate and sometimes the palatal arch from the tip of the uvula to the line of union between the premaxillary bones and the hard palate; while ten forms are complicated by clefts and misplacements of bones and muscles. No two are alike anatomically. Three of the group of the six forms of clefts are limited to the velum.

Here, as in the lip, the time and sequence of operations depend on the conditions presented.

If the cleft is of the soft palate only, in varying degrees, the operation is deferred until from the eighteenth to twenty-second month, to permit the thickening and strengthening of the tissues, the operation being performed just before speech is established. Should cleft lip accompany this condition, the lip is closed first, at from 4 to 6 weeks if the general condition warrants.

If the cleft of the palate involves the aveolar ridge, separating the maxillae from the premaxillae on either or both sides, to a slight degree or to the extent that the premaxillae protrude, a different problem confronts us. Here, the first step always is to adjust the misplaced bones in correct position, immobilize them and await their union before operating on the lip. If single, or bipartite, cleft occurs, the choice of time for operation is from four to six weeks after birth. If tripartite cleft presents, it is important that the child be not less than 3 months old when the operation of moving the premaxillae back into position is made. At this time, the bones are sufficiently ossified to retain their form. About two months after the bones have become firmly united in their normal position and a perfect foundation has been built upon which to construct a normal lip and nose, the lip operation is performed.

The pressure of the tongue in embryo, and later, no doubt, displaces upward the horizontal plates of the maxillary and palate bones which often stand at an angle of 70 degrees. This displacement renders the approximation of the distal parts of the cleft impracticable. The surgeon should lower these malposed bones to a more nearly normal position. This is done by adjusting silver wires through the bones, above the alveolar processes, and the germs of the teeth, always keeping above the horizontal plates of the maxillary and palate bones and that portion of the vomer that is bent in such a way as to become a part of the hard palate but below the floor of the orbit.

This adjustment of wires and lead plates, when correctly employed, lowers the malposed horizontal plates of the bones and approximates the anterior one third or one-half of the bony cleft and without disturbing any teeth, so that when erupted they will average well in regularity. I never have made the statement that I always approximate the bones in the posterior part of the cleft. Operation should be performed before ossification is far advanced, but I have moved the bones together in patients 4 years of age.

Besides the important step of securing union of one third or one half of the separated bones of the palate, including the management of the premaxillae, and the lowering of the

horizontal plates of the bones that form the hard palate, we have a further step to consider, and that is the control of the tuberosities in their relation to the soft palate. To place the tuberosities in normal position is also to place the muscles in normal position. Without a proper conception and execution of these three fundamental steps in palatal surgery, there is small hope of securing satisfactory form or function.

Closing the lip first, depending on the traction of the orbicularis oris muscle to approximate the bones, or passing a suture through the anterior part of the separated maxillae and thus bringing them together, cannot secure immobility and union of the separated bones.

The closing of the lip and the resultant traction of the orbicularis oris muscle *will* gradually move the anterior part of the cleft bones into contact, but the bones will not, as a rule, be normally approximated and united. Moreover, there cannot be union of the bones with the mucoperiosteum intervening. They only meet and remain malposed, leaving the patient deformed throughout life. The premaxillae should *always be preserved and utilized to establish and maintain the normal dental arch*, facial contour and the full complement of teeth. They should never be excised, for an irreparable deformity is the unfailing result.

When the anterior part of the cleft, which is nearly always wider at birth than the posterior, is brought together by the lip traction plan or by the single suture, the surgeon fails to give thought to lowering the highly elevated horizontal plates of the maxillary and palate bones, nor does he give consideration to the consequent separation of the bones posteriorly. Every surgeon experienced in this work should realize that, oftentimes, these bones become widely separated posteriorly, owing to the moving together of the anterior part of the cleft. These bones cannot occupy a normal position unless measures are employed to overcome their elevation and separation. With muscular force applied anteriorly and with no restraining force posteriorly, the maxillae act as levers, the malar processes becoming the fulcrums; and as the anterior ends of the maxillae are drawn together, the posterior ends, with the aid of the upward pressure of the mandible, move apart.

Unless steps are taken in early infancy to prevent the tuberosities from spreading (which is accomplished by the use of wires not only anteriorly but also posteriorly), the bones will separate widely and the palate will be shortened to such an extent that perfect speech will seldom be secured. When united, the soft palate will be tense, too short to reach the postpharyngeal wall and without flexibility or resilience. Utilizing a portion of each palatopharyngeal muscle will lengthen the palate in such cases. If lateral incisions are made in an attempt to relieve tension, a mass of cicatricial tissue will result, making the soft palate thick, inflexible and incapable of performing its normal function.

It must be remembered that lateral incisions oftentimes divide the fibers of the tensor palati muscle, which has a twofold function: to make tension on the palate and to dilate the pharyngeal orifice of the eustachian tube; which

may result in defective hearing, owing to the destruction of the continuity of the muscle and failure to dilate the tube. When the posterior wire is introduced in operating on the soft palate, it should be passed as nearly as possible through the center of the tensor palati muscle as it swings around the hamular process, thus suspending the contraction of the muscle until the palate unites.

The horizontal plates of the palate bones are elevated and the tuberosities are widely separated; consequently, the soft palate is also widely separated and may be, to some extent, atrophied for want of use; but the width of the abnormal cleft is not due so much to atrophy as to the malposition of the parts.

SUMMARY

In conclusion, I wish to emphasize these points.

1. Union of the separated bones of the palate and alveolar processes, with special attention to preservation and correct posing of the premaxillae, to be obtained before closure of accompanying cleft lip.

2. Bringing the malposed palatal plates of the maxillary bones downward by always passing the wire sutures *above* the alveolar processes instead of through them, thus bringing into proximity the edges of the cleft for one-third or one-half its length.

3. Prevention of spreading of the tuberosities by controlling them at the time of the anterior closure, thus laying a reliable foundation for constructing a normal soft palate by avoiding the cause of tension and shortness when united, and providing instead for length and flexibility, which is essential to correct speech.

PREOPERATIVE AND POSTOPERATIVE TREATMENT

Not the least important step in the correction of lip and palate defects is the preparation of the patient and the after care.

When the patient, if a child under 10 years, enters the hospital, the first step should be a careful general examination, preferably by a pediatrician, to determine the physical condition, diet requirements, etc. To counteract the acidosis, which is increased by fasting before operation and by the anesthetic, a 3 per cent sodium bicarbonate solution should be given in all feedings for at least three days preceding operation. Acidosis should be suspected in all cases, and the soda treatment liberally employed. Radiographing the chest is a part of the routine, to discover any enlargement of the thymus gland, a condition which would contraindicate administration of an anesthetic. If found, a roentgen-ray treatment is promptly given, one treatment usually being sufficient to reduce the gland to normal; after which, within three to six weeks, the operation may be safely undertaken. If exposure to a contagious disease is suspected, cultures should be taken from the nose and throat prior to operation.

I would counsel all surgeons against allowing parents or friends to urge haste in operation. They do not realize the importance of the certainty of a good condition, and allow the pressure of business or family cares to weigh too heavily. Plenty of time should be insisted on for preparation.

There should be no feeding for four hours previous to operation, and sodium bicarbonate should be administered to within two hours.

Before the child leaves the operating table and while he is still under the anesthetic, 6 per cent glucose, from 100 to 150 c.c., should be given by hypodermoclysis. Two hours after operation, glucose and sodium bicarbonate, in the above mentioned solutions should be given frequently by mouth. The first feeding is eight hours after operation, usually a small amount, but sufficient. After the lip and soft palate operations, quiet is imperative, and in addition to the foregoing treatment, it will probably be necessary to give paregoric (camphorated tincture of opium, U. S. P.). If we can keep the child on glucose for twenty-four hours or forty-eight hours after the soft palate operation, it is advantageous to do so.

The use of the actinic ray has been found of great value, both to sterilize the field of operation and to promote healing afterward.

DISCUSSION OF THE PAPERS OF LYONS, LOGAN, MOOREHEAD AND BROPHY:

George A. Dorrance, Philadelphia, Pa.: It is unfortunate that so many papers are written on the technic rather than on the speech results obtained in cleft palate surgery. I hope shortly to be able to give you the final results in as many as 500 cases in which operation has been performed by a great many different surgeons. I am positive that many men are optimistic about the speaking ability in these postoperative cases. There is little that is new in these papers. Dr. Brophy holds to his idea that the younger the child is when operated on, the less shock experienced from the operation. That may be true with his cases, but I find that the older the child is when operated on, the less the shock experienced. The adhesive plaster and bow that Dr. Logan uses in cleft lip is one of the most serviceable appliances that we have in this work. As regards the action of different muscles, there is only one muscle that pulls the palate upward, the levator palati. Now, why does not this muscle close off the palate after the operation? First and foremost, it is the tensor palati muscle, and it acts as a guy rope, preventing the levator palati from acting. In cleft palate cases, it is always short. In the surgery of any other part of the body, tendon lengthening would be done, but that is impossible here. The tensor palati muscle goes upward and then inward to form the two sides of a right angle triangle. In my cleft palate work today, I break off the hamular process, thereby allowing the tensor palati muscle to become an accessory elevator. In this way, not only does it assist the levator palati, but also any guy rope tension that might have existed disappears. I think this is more often done than the surgeon realizes. After a careful anatomic study of this region of the body, both on the normal child and on one cadaver having a cleft palate, I am sure that to obtain a satisfactory result, it is necessary to divide, or better change, this tensor into a levator palati. Another point Dr. Brophy insists on is that, if you wish to lengthen the soft palate so that it will close off, it is better to use the palati pharyngeus muscle. This action is to draw the palate outward and downward. Nature overcomes this by having the salpingopharyngeus and the levator of the pharyngeus elevate the pharynx. When this occurs, the palati pharyngeus relaxes, and has no action. Therefore I do not see how anything can be gained by lengthening the palate by the use of these muscles. Secondly, it does not make any difference how long the palate, the question is whether the levator palati can draw the palate up and close off the nose from the pharynx in conjunction with the superior constrictor muscle. When patients do not speak well after an operation or normally have a short palate, I sometimes use the following operation. I free the entire palate from its anterior attachment, dissect it back, separate the aponeurosis, divide the hamular process and allow the whole palate to fall

backwards for about three-quarters inch. Now, everything is relaxed, and we can easily sew the two sides of the palate without the least bit of tension, which is essential in these cases. Now, in the anterior part of the hard palate, there will remain an opening into the nose and mouth. This I close with an ordinary denture. In selected cases, this operation has proved very satisfactory in my hands. As for the time of operation, the lip and alveolar margin in every case should be operated on as soon as the child is in good condition. As to the time for the cleft palate cases—the closure of the posterior part of the hard palate—all say that this should be done before the child begins to speak. I disagree, for the following reasons. In the first place, there are two places where the cut off occurs, posterior to the eustachian tube and again in the anterior nares, and I wish to say that the anterior nares are of great assistance in the results in cleft palate cases. If they are stimulated in speech training, better results will be assured. The mortality in the cases that have been repaired early, say, from 2 years, is fairly high. Considering the whole country, and all classes of surgeons, it is at least 5 per cent. When the work is done at from 6 to 8 years, the mortality is not more than 1 per cent. In the literature on cleft palate, the experience of the older surgeons confirms this statement. If the child is operated on when it is very young, one or more operations are required; whereas, at from 6 to 8 years of age, one operation will suffice. I realize that the parents of these children are very anxious for early operation, but if they knew what I know, they would defer these operations until the child was 6 to 8 years old, when the tissues are much stronger and better to work on and the mortality is less. No one mentioned the Lane operation. Anatomically and physiologically, it is all wrong. I do not find many advocates of it except to close partial defects after one of the other operations. I would like to hear the general consensus of opinion on this operation as it is still quoted in the textbooks.

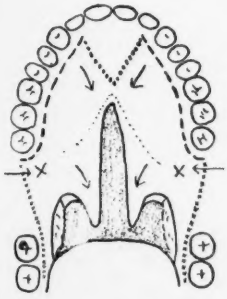

Fig. 1.—Dotted line, incision for retrotransposition (Lwow-Ganzer); broken line, incision for fissurorrhaphy (Diffenbach-Langenbeck); starred line, incision for mesopharyngoconstriction (Ernst-Halle); x, hamulus pterygoideus infraction (Billroth).

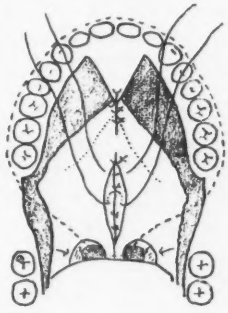

Fig. 2.—Retrotransposition; fissurorrhaphy; mesopharyngoconstriction. Broken line, celluloid plate.

A. Limberg, Leningrad, Russia: The surgical treatment of cleft palate must have for its chief aim not only its anatomic restoration, but also the restoration of its normal function. The operation must not involve either a maiming of the maxillary bone or impediment to its growth (maldevelopment). We use three typical operative methods for restoring the cleft palate to its normal anatomic shape and function: (Figs. 1 and 2). (1) fissurorrhaphy; (2) retrotransposition; (3) mesopharyngoconstriction. The first consists of the well known relieving incisions of Dieffenbach-Langenbeck, with exfoliation

of the mucoperiosteal flaps. But we cannot limit ourselves to this operation. It does not give the sought-for lengthening of the palate, and we cannot be sure of a primary union of the newly approximated edges. By continuing the incision forward up to the median line and by exfoliating the whole front flap up to the edge of the hard palate from which it has to be separated (severed), without, however, injuring the palatine artery, we obtain a retrotransposition. It is to be noted that, after this separation of flaps,

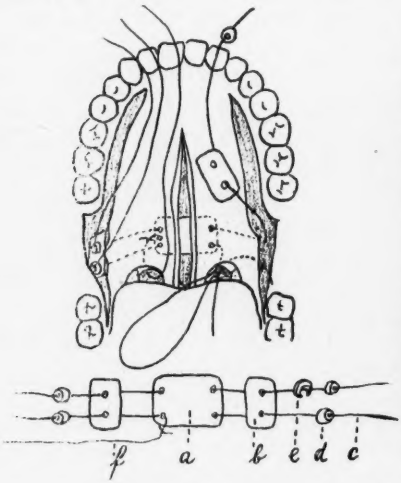

Fig. 3.—Plate sutures.

very often the whole soft palate shifts from 1 to 2 cm. backward by simple muscular traction. In cases of incomplete cleft, a v-shaped incision, proposed by Lwow[1] in 1925, is very convenient. If the cleft is more extensive, the Ganzer method is to be advised. The width, depth and height of the cleft and mesopharynx are always measured in our cases. These measurements, when compared with the normal, show us the unusual width of the mesopharynx in most of our patients. This circumstance gave Ernst[2] and Halle[3] (Berlin) the idea of a new method of operating, which can be designated as a mesopharyngoconstriction. An incision penetrating through the mucosa, beginning from the middle of the last molar and going vertically down to the lingual surface and average height of the mandible, is made. The muscles of the lateral wall of the pharynx are then bluntly separated though the *spatium parapharyngeum* (Corning, 1922, p. 125, Fig. 107) and pushed to the middle. By this operation, the joining of the edges of the cleft is made easier and the shape of the

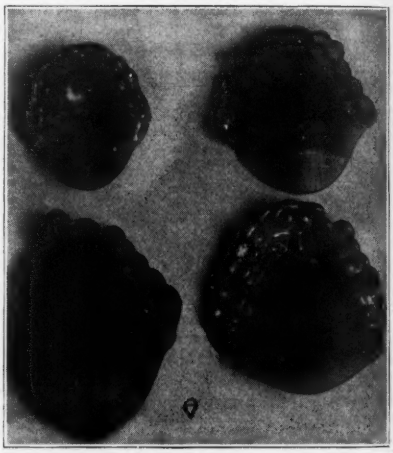

Fig. 4.—Occlusive celluloid plates.

palate is also improved. All these three operations can be done at one time. It is safer, however, to separate them. First, we can do the fissurorrhaphy and mesopharyngoconstriction, and some months later, the retrotransposition, if there is any need for it. All these new operative methods can be accomplished only with the aid of an occlusive celluloid plate, which, after the operation, is fixed to the teeth. The operative field is protected by it from contamination and the palate flaps are immobilized. (Figs. 2 and 4.) These methods usually make it possible for the lesion to close by primary intention. In the rare cases in which we have

1. Lwow: Seventeenth Russian Surgical Congress, Leningrad, 1925.

2. Ernst, F.: Plastic Operations on Hard Palate, Zentralbl. f. Chir., 52: 464 (Feb. 28) 1925. Arch. f. klin. Chir., 138: 170, 1925.

3. Halle: Ztschr. f. Hals-Nasen-Ohren-Heilkunde 12: 377, Part 2, 1925.

a partial separation of the edges, I apply plate sutures with the following new method (Fig. 3): A small celluloid plate (*a*) with two long, strong silkworm ligatures (*c*) is placed on the nasal surface of the soft palate. The ligatures are then pulled through the walls of the side wounds, where they are passed through smaller celluloid plates (*b*) and fixed by lead shots (*d*). The position of the side plates, which alone cause pressure, being perpendicular to the direction of the traction, makes cutting through of the stitches impossible and permits a drawing together of the flaps. These plates have a great advantage over the methods of plate sutures described by Blair, Brown and Brophy. I never make use of these methods because of the injury they may cause to the palatal flaps. The four ends of the silkworm ligatures are not cut off, but are left under the occlusive celluloid plate. In three or four days, we can enforce the traction of the ligatures by adding a second lead shot (*e*) between the first one and the celluloid plate. It is indispensable to tie a silk ligature to the middle plate (Fig. 3*f*), so as to be able to draw it away behind the velum when the treatment has come to an end. I have applied these methods in thirty-eight cases in patients from 2½ to 27 years, and in all of them, good results ensued. The approximated edges united by primary intention, and the shape of the palate was quite satisfactory. In four cases only, on the first dressing did we have a partial separation of the edges. An immediate appliance of the plate sutures gave the best results, so that the anatomic and functional restoration of the palate was gained by first intention, as in the other cases. I am sorry that I cannot explain all the particulars of these operations and the postoperative treatment because my time is limited. I have tried in these few words to give you an idea of the different methods we use for the restoration of the palatal cleft.

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Editorial

WHAT IS WRONG?

There is one subject in dentistry today which stands sadly in need of standardization. In connection with this subject, there is more confusion in the minds of the profession than regarding any other, unless it is the perennial question of pulpless teeth. We refer to full denture construction. In our literature in recent years, this topic has been treated extensively; in fact, it is well within the mark to state that more articles have been written about full denture work than about any other one topic. And yet in the face of all of this, and in spite of the consideration that has been given it, there seems to be as much uncertainty as ever in the minds, not only of the profession as a whole, but also of the full denture men themselves.

Something is wrong. Either this subject is particularly difficult of solution or there is lack of concerted effort on the part of the men most interested in it. Possibly both of these factors enter into the situation; but whatever the cause, it is high time that some-

thing be done to remedy the condition. No subject in dentistry is incapable of solution if the proper approach is made, and while full denture work presents certain inherent difficulties due to the patent fact that no two mouths are alike, either in their adaptability to artificial restorations, or in the individual habits of the patient; yet there are certain principles associated with it which are capable of standardization to a greater degree than exists today.

It is difficult to escape the suspicion that, among our full denture men, there is something more than a mere lack of cooperation. From the outside, it looks as if there was a deliberate pulling apart for the purpose of furthering some favorite idea. At least, this much may be said: there has seldom been manifest a magnanimous attitude, one toward the other, in the solution of the problem—no yielding of preconceived notions, which is always necessary in arriving at the truth.

Certain of our full denture men dwell on the fact that the most essential thing in this work is to obtain a correct impression; that the success or failure of the work hinges chiefly on this, and that, when a perfect impression is once secured, the rest of the technic becomes simple and easy. Others have been talking so much about occlusion, and particularly about articulators, that this has loomed as the paramount issue at stake, and every conceivable kind of articulator has been advocated, from a barn door hinge to the most elaborate (and, by the same token, the most expensive) contrivance in the imagination of man. The result is that, to the average dental mind, the subject has reached a point where it can be described only by the phrase "confusion worse confounded," and the time has arrived when something must be done.

Surely, the many bright and masterly minds in this specialty are capable of coming to a better understanding; surely, there is a common ground on which they may agree more nearly than they do today. All that is needed is a little better vision,

a little broader conception and a more scientific attitude of mind. By scientific attitude of mind, we mean, among other things, a willingness to accept the truth when it is presented, no matter whether it agrees with our preconceived ideas or not. There should be a more earnest search for the truth, and a lessened tendency to contend for a pet theory. There have been more theories advanced and fought for in full denture work than in any other branch of dentistry, and fighting for theories does not always reveal the truth.

Our full denture men should appoint a commission made up of leading representatives from all the opposing groups, and this commission should approach the problem in a generous and open-minded manner, with the sole idea of following the truth, no matter where it leads. It might take time to work out a solution of this problem, which must be acknowledged as a difficult one; but it would be time well spent, and the profession would be grateful. What is of greater moment, the people would be better served, and the rank and file of dentists would be able to approach this work with fuller confidence and more assurance of success.

As it now stands, the status of full denture work is not a credit to the profession, and we can never hope that it will be till the leading men in this specialty sink their prejudices and get together in a wholehearted effort to standardize the work and place it on a simpler and more nearly uniform basis. Who will be the Moses to take the initiative and lead us out of the wilderness?

DEPARTMENT OF DENTAL HEALTH EDUCATION

THE SELF-SELECTED DIET OF A NEWLY WEANED INFANT*

By CLARA M. DAVIS, M.D., Cleveland, Ohio

THE purpose of the experiment here described has been twofold; (1) to find out whether such a method of experimental investigation is practicable and safe and gives reasonable promise of worth while results, and (2) to observe what happens to the breast-fed infant who, from the time of weaning on, selects his own diet, and what the character of that diet is.

The relation of the experiment to current dietary knowledge and scientific investigation will be easily seen from the following considerations.

The aim of dietary science, as stated by McCollum, is a knowledge of an optimal human diet that shall tend to carry the health and vigor of youth into middle age and the later years of life to an extent not now generally known.

If such an optimal diet is generally desirable, its importance for the growing infant and child must admittedly be far greater; for, after growth ceases, even an optimal diet will not make over teeth, bones, organs and tissues jerry-built through faulty diet during the growth period. Nature, in accordance with this necessity, gives the infant *in utero* and during the nursing period prior claims on the nutritional resources of the mother so that it can take the lime salts out of her very bones and teeth, causing osteomalacia and caries; and the protein and fat from her body to a degree that produces emaciation. This gives the breast-fed infant a unique superiority in nutrition among all the human age groups, as is easily appreciated by the merest tyro who has the opportunity of seeing many breast-fed babies.

Since 1910, a better understanding of dietary mineral requirements, investigations of the proteins with respect to the variation in their amino-acid composition and hence in their nutritive value, and the discovery of the rôles of the vitamins and their important food sources have made our knowledge of what basic food elements an optimal diet must furnish, approximately, if not wholly, complete.

But how to market, cook and serve, or even how to prescribe, a menu that shall provide the needed eighteen amino-

*From the Pediatric Service of Mount Sinai Hospital.

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acids, eight minerals, three vitamins and the fats and carbohydrates that are found, not separately but in endless combinations in the common foods, so as to furnish the optimal diet, is, to say the least, a problem in permutations and combinations. So then, as McCollum puts it, "The end sought by students of nutrition is the discovery of the means of making the nice adjustments in a quantitative way among all the factors best adapted to promote optimum development, and of the means of preserving the harmonious rhythm of the metabolic processes in the best possible manner."

If we could apply the biologic method of experimentation used with animals and confine human beings in laboratories and study the effect of diet throughout the life cycle for several generations, it might hasten the attainment of the end. Man's long span of life practically precludes this, and the conclusions drawn from short-time experiments tend to be vitiated by the influences of previously acquired dietary tastes, prejudices and habits, as well as by the presence in the adult of considerable reserves of fats, protein, carbohydrate, important minerals and some of the vitamins. Experimental study of human diet is further complicated by man's well-known ability to exist in an apparent state of health whether as a strict carnivore or as a strict vegetarian, and the fact that he includes in his dietary during the greater part of life, purified, sophisticated or incomplete food products, not found as such in a state of Nature and further modified by cooking, mixing and the addition of flavoring substances, and lastly because we have not, as in the case of many wild animals, a natural model. We know neither what a man fed on an optimal diet would eat nor what he would look like.

The ideal conditions for human dietary experiments exist only in one age group, that from birth to weaning. This is a unique age, for here we have still the natural model, the breast-fed baby living on the one natural food provided for it, a food known from chemical and biologic investigations to be adjusted with an exquisite nicety to its optimal nutrition; living on this food just as it has done since before the dawn of history, totally oblivious of the changing dietary tastes, habits and theories of his elders. We know his characteristic appearance, how fast he should grow and develop, when his first teeth should appear. And so, with this age group and under these ideal conditions, pediatricians have for years been making experimental dietary investigations. The natural model has been carefully studied from every possible angle; the chemical, physical and biologic characteristics and properties of its optimal food, human milk, have been determined, and numberless experiments with modifications of other milks have been made in the attempt to reproduce artifically its optimal diet; the results of the experiments being always checked against the natural models. The closeness of the approach to the optimal in the planned diets used for this age group when the natural food is not available may be gaged by the fact that whereas 200 years ago almost all new-born infants for whom human milk could not be obtained died from causes directly connected with the feeding, such deaths have now fallen far below those due to the respiratory infections.

From the age of weaning on, and largely because of the prestige of our success with the infant of nursing age, we continue to prescribe the diets of our little patients, but here we are in the same situation as the student of adult nutrition: we have no natural models, no special data from experimentation under ideal conditions. Our dietaries for children are, therefore, made by combining scientific dietary knowledge with theory and experience, and many of us without much use of any of these simply pass on to mothers the routine diet lists that have been in use for some years, with careful directions as to quantities, etc. Whether the children fed strictly in accordance with our directions surpass in health, vigor and the quality of their tissues children who are brought up at a good plain family table without our advice, I do not know, but the complacency of many of us has been considerably jarred by noting how many of our children are brought back to us at some time during early childhood with the complaint of poor appetite and refusal to eat the food we think so good for them; by the fact that evidences of malnutrition are not unknown among them, and, lastly, by the consideration that, whatever may be their weight and height, and the condition of their well concealed organs and vital tissues, their teeth cannot be concealed and, fortunately, their dentists cannot be kept silent. Can, then, our diets for children from the age of weaning on be said to closely approach the optimal? I doubt it. Judged from the standpoint of growth in height, weight and muscle development, they are, in general, good; but these are relatively unimportant from the standpoint of maintained good health and long life, in comparison with the quality of bone, teeth, organs and vital tissues. Many a small, thin, poorly muscled person outlives his well muscled friends of normal weight, and while our biologic friends who claim longevity as an hereditary character may be right, the claim can hardly be held as proved until it has been shown either that long life is a transmissible hereditary characteristic in animals, or that good nutrition does not improve resistance to infection and prevent premature breakdown of important tissues under ordinarily endurable strains.

These general considerations made further dietary experimentation with children seem desirable, and the following particular considerations suggested a new method, i.e., the use of the age group that first receives other food than breast milk, and the use of a self-selected diet of simple natural foods.

The choice of the age group was made for the following reasons:

1. In healthy breast-fed infants nursed by healthy, well-fed mothers, we still have, at the time for weaning, a unique group for the purposes of dietary experimentation, natural models as yet untampered with from a nutritional standpoint, with no conscious dietary theories or habits, and presumably freer from nutritional defects than any older children that can be found at the present time.

2. To proceed from the age of infancy, at which our information in regard to the optimal diet is most complete, to the age immediately following seems to promise more important and trustworthy results than to skip to an older age group in which the interval diet of the individuals could not have been uniform.

3. These infants are at an age when dietary and environmental control are relatively simple.

The self-selected diet of simple natural foods was chosen as the means of experimentation because, before proceeding to try out an infinite number of diets that might be planned in accordance with our best current dietary knowledge, it seemed worth while at least to ask Nature's only surviving model of human nutrition in our midst, the breast-fed infant ready to try his first two teeth on something other than milk, what he knows about diet for himself, especially as he seems to be the only one who has not been previously consulted on the subject. This method would, it was hoped, throw some light on whether the infant at this age has any instinctive means of handling the problem of nice adjustment either qualitatively or quantitatively.

The questions to be put to him by this experiment were:

1. Could he, and would he, at this age, choose his own foods from those placed before him as do adults, and in sufficient qualities to maintain himself?

2. If so, would he maintain himself in a state of digestive health or would he have impaired digestion, with vomiting, diarrhea or the presence of undigested food in the stools, and general discomfort?

3. Would his growth, the further eruption of teeth, his gain in weight and general well-being equal those of infants fed in the usual way on the usual limited diets commonly prescribed?

4. Would he eat indiscriminately everything offered, governed only by his caloric needs, or would he show well-marked preferences, and, if the latter, would he be vegetarian, carnivorous or omnivorous?

In other words, the experiment would ask him whether he needed a physician to prescribe what foods he should eat and how much of them, and a mother or nurse to urge, force, coax or restrain him in his eating; or whether he could manage his own gastronomic affairs provided he had access to a wide range of natural foods.

For such an experiment, the baby, E. H., was brought to Mt. Sinai Hospital Jan. 26, 1926. He had been exclusively breast-fed since birth with the exception of a recent period when he had been given a supplemental formula feeding; and, on few occasions, he had had a little beef broth, because of his mother's milk supply being scanty. He was 9 months old, and 28¼ inches long and he weighed 19 pounds. He had two lower central incisor teeth, and showed normal development and behavior for his age. The hydrogen-ion concentration of his gastric contents on exclusive breast-milk feeding was found on four successive days to be that normal for breast-fed infant of his age, i.e., 3.1. He had a slight mucous rhinitis, a rather large mass of adenoids and, as roentgen-ray examination later showed, a deviated nasal septum. Unfortunately, too, as it seemed to us then, although we soon ceased to regret it, he was not nutritionally the strictly normal baby we had hoped for, but had active rickets. This may have been due to the fact that his unmarried mother was a thin, undernourished girl, whose diet had not been optimal for lactation, or to the fact that he had never been out doors except in being taken from one institution to another.

He had never seen an adult or older

child eat a meal, so all possibility of the influence of example in eating was eliminated.

January 31, the experiment of allowing him to manage his own diet was begun, and it has now been in progress for six months. The method of asking the questions, i.e., conducting the experiment, has been the same throughout. No food is offered to him either directly or by suggestion. His tray is placed on a table at which he sits on a chair. On the tray (Fig. 1.) are small sauce dishes containing the various articles of food and glasses containing the milks or other liquids. The nurse's orders are to sit quietly by and make no motion. When, and only when he reaches for or points to a dish, she takes a spoonful and, if he opens his mouth for it, puts it in. She may not comment on what he takes or does not take, point to or in any way attract his attention to any food, or refuse him any for which he reaches. The tray is taken away at the end of thirty minutes or earlier if he has definitely stopped eating. He may feed himself in any way he can without comment or correction of his manners. He eats in the young infants' nursery, not with infants of his own age or older children.

Now lest it be inferred that this experiment is nothing more than the popular one of setting the baby up to the family table and seeing what it will take, let us consider for a moment the menu we offer this baby. The food list, given in Table 1, has been assembled with the object of presenting a wide range of simple natural foods unaltered to appeal to the palate. Each article, even salt, is served in a separate dish so that each must be chosen for itself alone. No salt is added to any of the foods, no milk poured over the cereal. No mixes, combinations of food or made dishes, not even bread or soups, are included. The list does not include any refined or sophisticated foods, such as sugar, any seasonings or flavors except salt (served separately), any incomplete foods, such as articles made of white flour or ordinary rice, any canned or preserved foods. No limit is placed on quantity. He may eat as much as he wants of any article. If, as has happened occasionally, he eats

Lactic Milk Whole Milk Cooked Marrow Raw Beef Cooked Beef
Chicken Sea Salt Ordinary Salt Carrots Raw
Cooked Turnips Cauliflower Rye Krisp

Fig. 1.—Typical meal as served.

all there is of any article, at the next serving the size of the portion is increased to insure some being left. All but a few of the articles have been on the list since the beginning of the experiment. No further additions or changes are contemplated, and the list

TABLE 1.—LIST OF FOOD USED IN EXPERIMENT.

1. Meats (muscle cuts)
   - Beef
   - Lamb
   - Chicken
2. Glands and organs
   - Liver
   - Kidney
   - Brain
   - Sweetbreads (thyroid and thymus)
3. Bone products
   - Bone-marrow (beef and veal)
   - Bone-jelly (soluble bone products)
4. Sea food
   - Sea fish
5. Eggs
6. Milks
   - Certified raw sweet milk.
   - Certified raw whole lactic milk
7. Vegetables
   - Lettuce
   - Cabbage
   - Spinach
   - Cauliflower
   - Peas
   - Beets
   - Carrots
   - Turnips
   - Potatoes
8. Fruits
   - Apple
   - Banana
   - Orange
   - Pineapple
   - Tomato
9. Cereals
   - Wheat (whole)
   - Barley (whole grains)
   - Cornmeal (yellow)
   - Oatmeal (Scotch)
   - Rye (rykrisp)
10. Salts
    - Sea salt
    - Table salt

as it is will be used for the next infant from the time of weaning on.

Two articles not on this list were also on the tray during the first four months, cod-liver oil and a synthetic milk (S.M.S) containing cod-liver oil. It was thought that, as the infant had active rickets, it would be interesting to see whether he would choose to take cod-liver oil in any amount. This will not be done again under similiar circumstances.

The list includes representative foods from all the main classes of natural foods: fruits, vegetables, cereals, muscle meats, glandular organs, bone-marrow, milk, eggs, sea food and one mineral salt, sodium chlorid.

Cereals are all whole grains with the exception of corn meal, we having only recently found a source for obtaining whole corn meal. Milk is raw certified milk served always as such and also made into whole lactic milk (sour milk). Cooked vegetables and other foods are cooked *en casserole* without the addition of water or loss of juices or soluble substances.

Since the entire list cannot be gotten ready and served at one time, the articles are served at four meals, this arrangement providing a wide variety at each meal. Both kinds of milk, two kinds of cereals, either fruits or vegetables, and animal protein foods are served at every meal. All portions are weighed or measured before serving, and the remains weighed or measured on the return of the tray to the diet kitchen, so that the fat, carbohydrate and protein can be calculated as well as the amount of each mineral element.

Needless to say, this involves an enormous amount of work, and its accomplishment would have been impossible without the splendid cooperation of the hospital dietitian, Miss Helen Mallory, and her assistant, Miss Wallace, who has herself personally supervised the preparation of the food and has done all the weighing and recording.

Now what did this breast-fed baby do, January 31, when, for the first time,

he was put in a high chair with a tray full of sauce dishes of solid food and glasses of liquids on the table before him? He looked at the tray for a few seconds, then reached for the dish of raw carrots and plumped the whole of one hand into it. The nurse took up a spoonful; he opened his mouth, and she put the spoonful in. He sucked the carrots off the spoon, made a few chewing motions and swallowed them. Back went his hand to the dish, and the proceeding was repeated over and over until most of the carrots had been eaten. He also ate liberal amounts of raw beef and of milk at this first meal. Lettuce he tried, but he apparently thought little of it, allowing the second spoonful to run out of his mouth and not touching the dish again. Within three days, he had tried almost all the articles, eating little of some and much of others. He had answered our first question: he could and would indicate his choice of foods without suggestion from anyone when given a chance to do so and would eat an adequate amount.

From that meal on, he has, for more than six months, with the exception of two short intervals which will be discussed later, eaten nothing that he has not chosen for himself. After the first two or three days, he indicated choice by touching the dish or food with his index finger and looking from it to the nurse. Since the age of 14 months, he has fed himself for the most part, eating with his fingers and picking up and drinking from the glasses without aid.

Whether his choice was at the very first only a random one or whether he was influenced by color or odor or both is a psychologic question that I am not competent to answer. Inasmuch as the experiment was a nutritional and not a psychologic one, no attempt was made to get data on that point by disguising foods or use of other methods to discover motives for choice, it being thought that such procedures might confuse the experiment for our purpose. There could be no question that, after the first two or three meals, he promptly recognized and chose the things that he wanted, as he reached for them without hesitation no matter what was their location on the tray, often neglecting others closer at hand.

He has shown himself to be omnivorous, but with decided preferences. Until his blood calcium and phosphorus became normal, that is, while he had active rickets, he ate liberally of vegetables as well as of fruit, meat and cereals, of which he has always eaten freely. Since that time, he eats only small amounts of vegetables, his diet being more of a carnivorous type. He drinks both sweet and sour milk, but more of the sweet. On first eating salt, he screwed up his face, but he did not spit it out, and after sputtering a little over swallowing it, reached for more. He shows a marked fondness for bone-marrow and for glandular organs, and has eaten as many as five eggs at one meal. While his general preferences can be easily appreciated both from watching him eat and from noting the weighed amounts taken, it has been impossible, thus far, to make any predictions as to what he will choose at a particular meal. This behavior in eating resembles that of adults who prefer

one thing one day, another another. Like adults, too, he always eats several articles of food at a meal, and interrupts his eating of solid food several times to drink.

He has given no clear answer to the question of a preference for raw or for cooked foods. During the first three months, he preferred raw to cooked beef; since then, he has taken both equally well. Eggs, bananas, and carrots he seems to prefer raw; peas he likes equally well raw or cooked and bone-marrow, oatmeal and wheat he definitely prefers cooked.

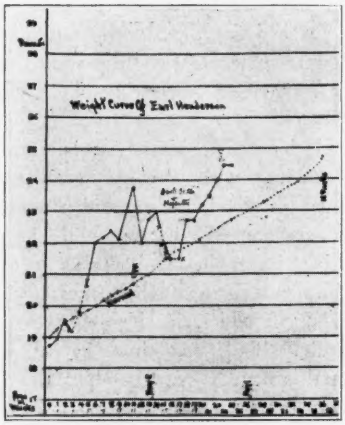

Fig. 2.—Weight chart.

His daily intake of milk has varied in quantity as greatly as that of individuals solid foods, i.e., from 11 to 48 ounces.

This, in brief, is what he has done with the diet list. The questions as to what his self-selected diet has done to him concern digestion and nutrition. Having accomplished the feat of choosing his food, how has he fared when it came to digesting it?

He has never had a poor appetite, never vomited, never been constipated, never missed a daily evacuation of the bowels, never required a cathartic, and never given any evidence of abdominal discomfort or pain. The hydrogen-ion concentration of his gastric contents has been maintained at the optimal for gastric digestion except at the onset of an acute respiratory infection, and no indican has ever been found in his urine. He has had no diarrhea nor undigested food in the stools except for three days at the onset of an infection. This occurred in the latter part of February, three weeks after the beginning of the experiment and during the early part of the influenza epidemic. On one day, he appeared to have a slight cold, and the hydrogen-ion concentration of his gastric contents dropped to 5.5, i.e., lower than the zone of good gastric digestion for breast-fed infants. The next day, he had a frankly purulent nasal discharge, and soon loose stools, with blood and mucus as well as undigested food. The experimental diet was then discon-

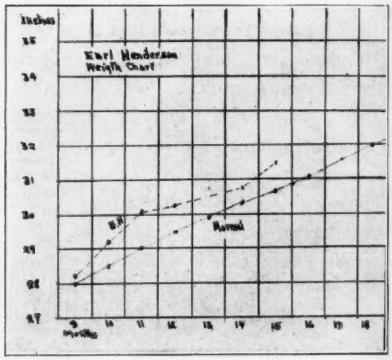

Fig. 3.—Height chart.

tinued, and he was kept on lactic acid milk with karo corn syrup until the hydrogen-ion concentration of the stomach contents was again normal (two weeks), when the experiment was resumed. At the onset, we naturally blamed the diet for the intestinal trouble, but as other infants (breast-fed or on exclusive milk diets) were seen in private practice and brought into the hospital suffering from the same condition, which in all cases was initiated by a mucopurulent nasal discharge, we came to the conclusion that these were cases of the intestinal influenza described by Holt.

From this time on, the baby continued to have a purulent nasal discharge, and in May, he suffered an attack of double otitis media with a mild hemorrhagic nephritis. Again the hydrogen-ion concentration of the gastric contents dropped, and although no digestive symptoms appeared, the diet was discontinued for a week, at the end of which time, a mass of adenoids were removed. The experimental diet was resumed, and he made a rapid recovery

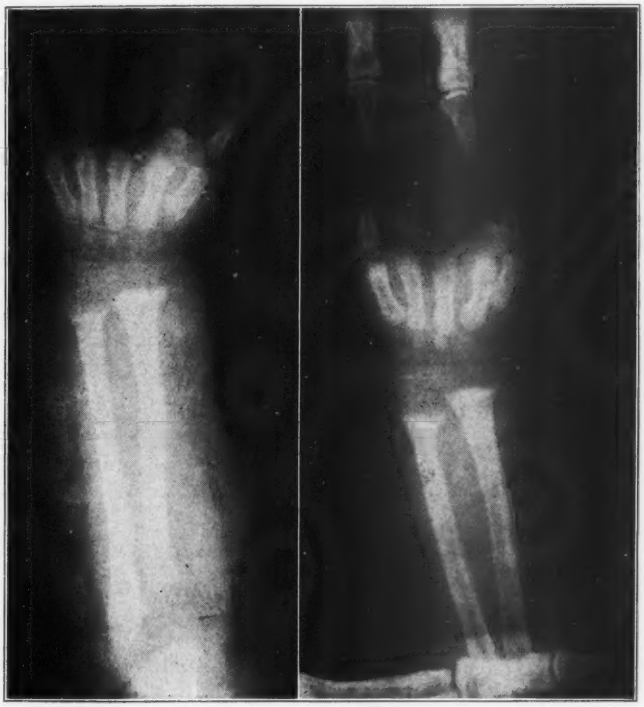

Fig. 4.—Condition of active rickets at beginning of experiment. (Age of infant, 9½ months.)

from the nephritis, despite his high protein intake.

Fig. 5.—Condition at the age of 10½ months (rickets probably healing).

His growth and development are shown on the accompanying weight and height curves, in which the lower curves represent the normal curves (Figs. 2 and 3). Except at the beginning of the experiment, when his weight was slightly under normal, and the week during which he had the otitis media, both weight and height have been above average, and, at 15 months, he was the height and weight of an average 18-months-old baby. The tone of his muscles is excellent. He walked at 12 months, alone at 14 months. He has been exceptionally happy, contented and free from nervousness or irritability, a point used by animal experimenters as one test of successful feeding. Three different observers, one a specialist in mental hygiene, on separate occasions and quite unknown to each other used the same word to describe his mental state when they expressed themselves as struck by the "poise" of the baby.

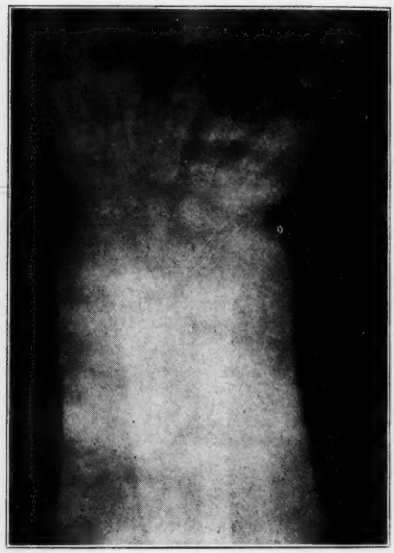

Fig. 6.—Condition at the age of 11½ months (rickets healing).

The bone-building qualities of the

diet chosen can be judged by the course of the rickets and best followed by the roentgen-ray films of the radius and the chart of the blood calcium and blood phosphorus (Figs. 4-9).

The next to the last film, taken soon after the acute attack of otitis media, shows apparently a normal bone, very well calcified. From this film, the diagnosis of healed rickets could not be made since no transverse line shows where growth and calcification were interrupted and resumed. The last film shows such transverse lines, and it seems probable that their absence in the preceding one was due to the same depressing influence of infection on growth that is shown in the height and weight curve, rapid growth being promptly resumed as soon as the infected adenoids were removed.

The abnormally high blood phosphorus, 6.8, was found during the nephritis and was the usual phosphate retention that occurs in that condition (Fig. 10). Those obtaining since are high normal values.

Fig. 7.—Condition at the age of 12½ months (rickets nearly healed).

The amount of pure cod-liver oil he had voluntarily taken in the four months was 47½ drams, and the amount of cod-liver oil that he took in the S.M.A., 21 1/3 drams, a total of 68 5/6 drams in 101 days, or about 2/3 drams a day. He had no treatment with ultraviolet rays, and had been out doors very little, owing to the late season, inclement weather and the chronic nasal discharge.

The anterior fontanel was completely closed at 13½ months (average age for closing, 18 months), and so smoothly that its location could not be determined by palpation.

The dentition as compared with that of the average nonrachitic infant is shown in Table 2.

At no time has he shown any discomfort or disturbance of health from dentition.

I shall not weary you with statistics as to the actual composition of his diet in its basic elements. The analyses of it are not complete. As far as studied, it has been and still is an extremely high protein, high fat diet as compared with the customary ones, and the most complete proteins from the standpoint of their amino-acid content, the glandular organs, have been eaten abundantly.

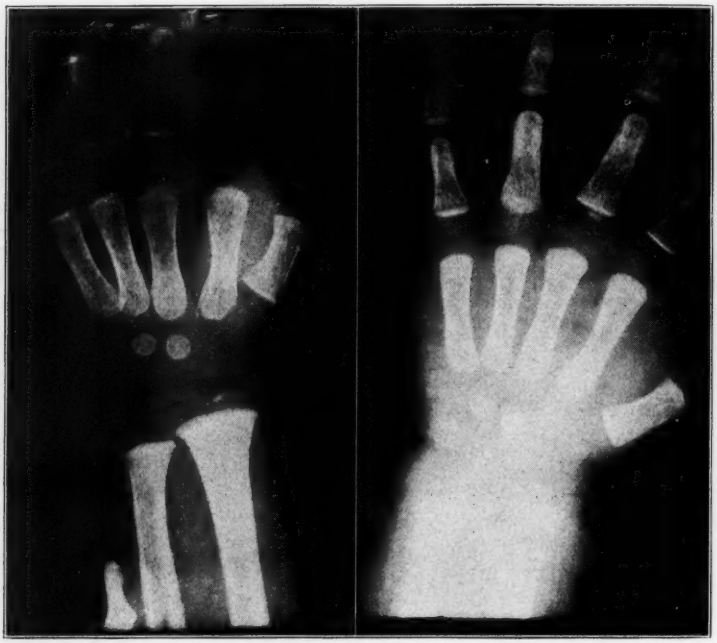

Fig. 8.—Condition at the age of 14 months (rickets healed).

TABLE 2.—DENTITION AS COMPARED WITH THAT OF AVERAGE NONRACHITIC INFANT.

Age Months	No. Teeth	Average
9	2	2
10	3b	2
11	5	3
12	5	4
13	5	5
14	7	6
15	9	7
15½	12	8

SUMMARY OF RESULTS

Summarizing the results of the experiment in the case of this one infant, it may be said:

1. He was able from the beginning to select his diet without aid from anyone; was omnivorous, but showed marked preferences, thus supporting the

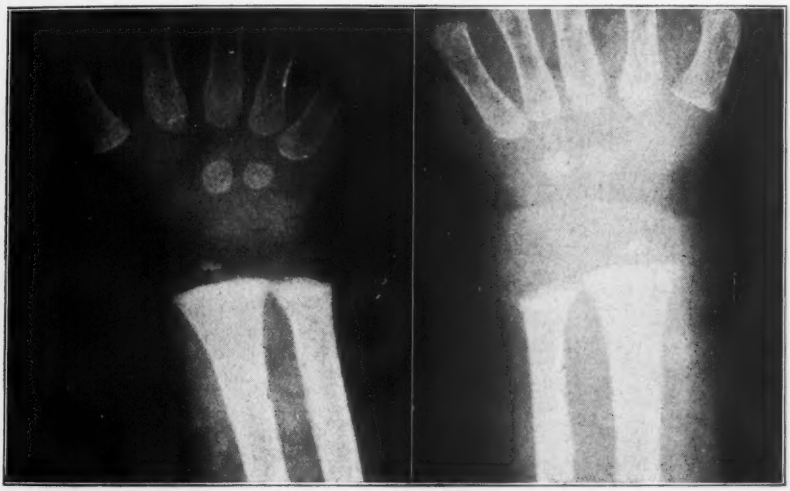

Fig. 9.—Condition at the age of 15 months (rickets healed).

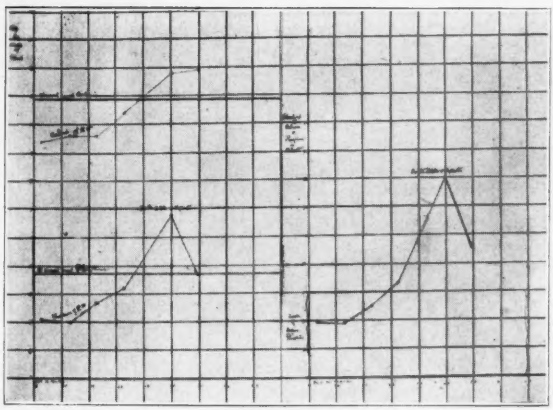

Fig. 10.—Blood calcium and phosphorous curves, and the curve of their product during the experiment.

views of McCollum that the young animal eats not only because of his caloric needs but because of desire for definite foods.

Fig. 11.—E. H., at the beginning of the experiment (age, 9½ months).

2. From the point of view of digestion, the diet he selected appears to have been optimal, since, except in the presence of acute parenteral infection, he gave no evidence of the slightest digestive distress or disorder, and maintained the hydrogen-ion concentration of his gastric contents at the optimal for gastric digestion of his age. The normal character of the stools, absence of diarrhea or constipation and absence of indican in the urine speak for the excellence of his intestinal digestion.

3. From the standpoint of nutrition, no conclusions as to the ultimate value of his self-selected diet are warranted from the continuance of it for only six months. The immediate results appear to be equal, at least, to the best results obtained by prescribed diets, i.e., growth in height and weight, general appearance of well-being, and absence of irritability. His count of red blood cells, hemoglobin percentage, and

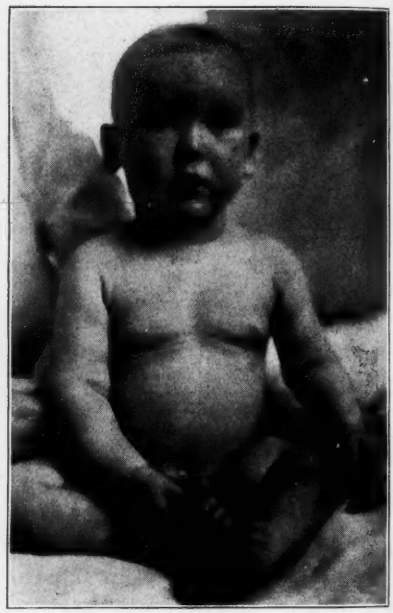

Fig. 12.—E. H., at the age of 12½ months.

blood calcium and phosphorus are all above the commonly accepted averages for healthy infants of his age. Dentition, which is usually retarded in infants who have had rickets, is in advance of the average.

Fig. 13.—E. H., at the age of 14 months.

4. No protection against infection was evident, although definite conclusions cannot be drawn, since the purulent infection of the adenoids occurred during the first month of the experiment and before the rickets was healed or the calcium and phosphorus percentages had been brought up to normal.

From these results, it appears that:

1. The self-selected diet of simple natural foods seems to offer a safe means for dietary experimentation on the breast-fed infant at the time of weaning.

Fig. 14.—E. H., at the age of 15 months.

2. Thus far, no support is given to the prevailing belief that the infant of this age cannot digest or use any of the common simple natural foods of adult life, or that glands and muscle cuts of meat which have been shown to be especially valuable proteins in their variety and combinations of amino-acids should be excluded from the diet.

3. It is desirable that a sufficient number of healthy breast-fed infants whose mothers have had ample diets during lactation, and who are free from rickets or other nutritional disability, be investigated by this method in order to determine

(*a*) Whether there is any uniformity of choice, and if so the basic composition of the chosen diet.

(*b*) What the effects of such diets are when continued over longer intervals of time, especially on tooth, organ and tissue development, kidneys and blood, and resistance to infections.

(*c*) Whether the method promises to be of value in the search for an optimal diet for infants of this age (Figs. 11-14).

PROGRAM OF THE HYGIENE COMMISSION OF THE INTERNATIONAL DENTAL FEDERATION*

By ERNST JESSEN,† Basel, Switzerland

THE Seventh International Dental Congress, at its closing session, Aug. 28, 1926, selected Copenhagen, Denmark, for the next meeting of the International Dental Federation, and chose Aug. 6-9, 1927, for the date of meeting. Of the fifteen sections of the Congress, only Section XI (Mouth Hygiene, Preventive Dentistry and Public Health) presented an outline of the program for the meeting in Copenhagen. The subjects presented for consideration at the meeting of the Hygiene Commission of the F. D. I., at the meeting in Geneva in 1925, were approved by the Congress, and thereby the proposed activities of the Hygiene Commission were accepted as fundamental bases upon which the further service is to be built.

The following are the subjects for consideration:

1. The *nourishment* of the prospective mother and the care of the infant from the time of birth to school age constitute the foundation upon which rests the development of strong and healthy teeth.

2. The *school dental clinic* is the foundation for the subsequent care of the health of the people in preventing and battling the infectious diseases, especially tuberculosis.

3. The *public dental clinic* constitutes the continuation of this service. The aim is to secure the establishment of dental clinics by the health authorities of various countries, with a dentist as the director; and to develop the service so that it shall be conducted on the same plane as the general health service.

4. The *scientific work* shall be in charge of an International Institute with branches in all countries.

5. The Hygiene Commission of the F. D. I., shall execute the orders of the Congress.

*To be presented at the annual meeting of the International Dental Federation, Copenhagen, Denmark, Aug. 6-9, 1927.

†President of the Hygiene Commission.

6. It is to the interests of the entire dental profession, through its organizations in various countries, to further these efforts.

The first subject on this program presents to us an important and at the same time a difficult problem. We have an excellent example of what may be accomplished in this direction in the Forsyth Dental Infirmary for Children in Boston, under the able direction of Harold DeWitt Cross. This institution, originally designed for school children, was built in 1912-1914, through the generosity of the Forsyth Brothers, at a cost of about $2,000,000, with an annual upkeep of over $100,000, and a daily attendance of from 300 to 400 children. The problem of this institution is the proper nourishment of the prospective mothers and their children. Only children under 6 years of age are admitted, and they may remain under the dental care of the Institute to their sixteenth year. Up to the time of the meeting of the Congress last year, 173,000 children had been treated.

An excellent example of a dental clinic for school children on an equally magnificent scale is the Rochester Dental Dispensary founded by Mr. Eastman, and under the able direction of Harvey J. Burkhart, who was the president of the Section on Mouth Hygiene, Preventive Dentistry and Public Health at the last Congress. In addition to the dental care given to children, one of the principal objects of this institution is to prepare and educate dental hygienists. After a one-year course, a diploma is given which is recognized by the state, in clinics, in hospitals, in the schools and in private offices. Their service includes cleaning of the teeth, massage of the gums and instruction in the care of the teeth and oral cavity, as well as in dietetics.

We trust that the chairmen of the various subcommittees and those writing on the dental care of children and of the public, will make suitable recommendations for the furtherance of our efforts, in accordance with the following agenda:

1. In addition to the hitherto exerted activities in the *community* field, that is, in furthering dental clinics in schools and for the public in all countries, it is the aim of the Hygiene Commission of the F. D. I., in the future also to turn its attention to scientific research.

2. For this purpose, it is proposed to establish in Paris, an "International Institute of Public Mouth Hygiene," with branches to be established in all countries, as far as this may be possible.

3. In close cooperation with the Hygiene Section of Switzerland in Geneva, the Hygiene Commission will endeavor to assist in solving the problems and in assisting to accomplish the laudable aims of that Section.

4. As an international organization, we place our work and service at the disposal of the health authorities in all countries, and will put forth efforts and devise ways and means which for each community may be deemed most effective.

5. We shall endeavor always to conform to the customs and the national consciousness of various peoples, and therefore act only in the capacity of advisers, leaving the application to the effective organizations of the various countries.

6. In order that general information may be broadcast, and that united

action of all peoples in the field of public mouth hygiene may be effected, it is desirable that the publication of the Hygiene Commission should be further developed, and regularly appear in the four official languages of the Congress, and that it shall be sent gratis to all who are interested in this field.

7. It is the aim of the Hygiene Commission to secure such funds not now available, from contributions on the part of various governments, private contributions and endowments, for the furtherance of general public health.

8. With the cooperation of the F. D. I., the Hygiene Commission requests dental organizations in all countries, to further earnestly the social and scientific efforts toward improving the general health of the people.

A PLEA TO THE PROFESSION

The Massachusetts Department of Public Health recently circularized the members of the Massachusetts Dental Society with the following letter:

TO THE DENTAL PROFESSION OF MASSACHUSETTS

A Plea

The Massachusetts Department of Public Health asks the cooperation of every practicing dentist in Massachusetts in furthering its new program for the prevention of tooth decay. Any dental hygiene program is in the last analysis dependent on the practicing dentist. Health authorities, specialists, doctors, nurses and dental hygienists may unite in an effort to teach the public certain facts now known concerning teeth, but if they are not backed by the dentists, the whole program will fail and the public will be confused.

In May, 1926, the Department of Public Health with the aid of its Dental Advisory Committee drew up a new policy for Dental Hygiene work. The main body of its policy is based on the operating policy used at Forsyth Infirmary. Statistics have proved that the Forsyth program is actually getting "results," saving thousands of teeth by treating them before decay has started. It is the responsibility of the State Health Department and the dental profession to spread this message to all communities so that old inefficient methods may be abandoned and a new hold taken on the problem.

There are certain definite facts concerning teeth that the State Department has made the basis of its working program. These are—

1. The importance of dental and nutritional care during pregnancy, infancy and early childhood.

2. The relation of proper nutrition to tooth development.

3. The importance of dental treatment for deciduous teeth.

4. The advantages of filling fissures and pits in permanent molars immediately after eruption and before decay starts.

These same facts form the basis of the resolutions passed by the Massachusetts Dental Hygiene Council and resolutions which have been adopted by fourteen State Societies, ten Local Societies, American Dental Association, Canadian Dental Association and Commission on Oral Hygiene of the International Association.

Printed material has been developed to cover this information in a simple direct way. Charts showing developing teeth and fissures to use in lecturing to adults have been made. A delineascope film for children telling the story of tooth development is now ready for use in the schools.

With this as a foundation a working program has been developed. This program falls into two sections, what we advise for the towns now conducting dental clinics and what we advise for towns or private organizations contemplating work.

There are around 160 dental clinics now running in this state. The majority are attempting to treat a large group of children with no definite age limit or policy for trying to make the program preventive. The work is spread out and each year the problem

is what it was the year before. We recommend to these communities—

1. That they establish a seven year age limit. (In most cases there are enough children in this group to keep the dentist busy throughout the year—and yet they have been trying to cover all eight grades).

2. That they open the clinic to preschool children. (Concentrating at first on the permanent molars and, as the program develops, taking care of the deciduous teeth).

3. That the dentist have the following operating policy—

a. Fill all fissures and pits in first and second teeth.

b. Do no root canal treatment or conservative pulp treatment.

c. Extract all teeth not amenable to simple fillings. (Fill only such cavities as can be done without danger of pulp involvement.

4. Extend clinic service to prenatal cases. (This is not possible in many cases now, but it is an objective to work for).

This will mean that our clinics, instead of doing a slipshod piece of reparative work will operate on the best preventive program now known to the dental profession.

To the community contemplating work we advise much the same thing. If town money is to be spent we do not recommend that clinics be established. It should be spent for educational work either through a traveling dental hygienist or a permanent dental hygienist.

On the other hand private organizations may well undertake the giving of clinic service. To such organizations we recommend:

1. An operating policy similar to the one just discussed.

2. The work done by a local traveling dentist.

3. The entire cost as far as possible paid by the parent.

It is the first section, the recommendations to clinics, that is our program for the present. This has been presented to the staff members of the Division of Hygiene, to the district health officers, to a group of Parent-Teacher Association delegates, to two groups of Maternity and Child Hygiene nurses, at four Child Hygiene Conferences, and to twenty individual towns.

We are trying to reach all the health authorities in the state and the prominent members of all local communities. It is at this stage that we appeal to you for your active cooperation. Nothing is more discouraging than to tell a nurse or a parent that certain treatment should be given new molars or badly decayed first teeth, and have the family dentist say that it should not be done. It happens frequently. We are confident that a thorough explanation of the program will show that we are working toward prevention, that what we recommend is what we know to be the best treatment for a large group, not what may be done in private practice.

Once this is thoroughly understood we know that every ethical dentist will want to join forces with us and push a program that will accomplish in a short time what years of the other policy will never accomplish. We have passed the stage of propaganda—our people know that teeth are important. Now is the time for slow, steady work at the foundations. We ask your help.

GEORGE H. BIGELOW, M.D.,
Commissioner of Public Health.

FIELD NOTES

A page of one of the Sunday issues of the Grand Rapids paper was devoted to the work of the staff of the Grand Rapids School Dental Clinic. The headline read "Inspected Teeth of 25,500 Children," and the writeup gave a detailed and authentic report of the excellent work being carried on in Grand Rapids. Such publicity is not only of value to the clinical workers, but must also be of great satisfaction to the taxpayers. H. B. McMillan is director of the service.

Owensboro, Ky., is developing a community dental program. Thirteen local dentists are giving one day a week and are supplying the equipment and material necessary to care for the teeth of indigent children. The superintendent of schools and the teachers are manifesting keen interest, and hope together with the dentists, to conduct an examination of all school children. Interest has spread throughout the county, resulting in a request by the parent-teacher association for a county examination and clinic.

Medical and Dental News

Alabama

Annual Meeting of State Society: The Alabama Dental Association held its fifty-eighth annual meeting, April 12-14, at Montgomery. Papers and clinics were presented as follows: "Conservative Surgical Treatment of Periodontia, by Olin Kirkland, Montgomery; "Clinical Considerations of Fixed and Semi-Fixed Bridges Together with Radiographic Observations," by Stanley D. Tylman, Chicago, Ill.; "Oral Surgery of Interest to the General Practitioner," by Guy R. Harrison, Richmond, Va.; "Some Phases of Dental Economics," by Ralph R. Byrnes, Atlanta, Ga.; "Efficient Radiographic Service in Dentistry," by Clarence O. Simpson, St. Louis, Mo. At the Wednesday evening session, April 13, Miss Evelyn C. Schmidt, Chicago, director of the Department of Dental Health Education of the American Dental Association, discussed public health problems.

California

Dr. Banzhaf Addresses Joint Meeting: San Francisco Medical and Dental societies, meeting in joint session, at the Medical Club, were addressed by Henry L. Banzhaf, President of the American Dental Association. A dinner was given in Dr. Banzhaf's honor, at the Elks Club, previous to the meeting.

Medicodental Building at San Diego: The new medicodental building being constructed at Third and A streets, San Diego, as a home for the medical and dental professions is expected to be ready for occupancy by June. It is a reinforced concrete building with a terra cotta and face brick exterior, and marble lobby and corridors. All offices are outside offices with built-in conveniences such as special roentgen-ray wiring, compressed air, forced ventilation, electric outlets for power and lighting, properly placed gas outlets and a water-softening plant. An entire wing on the fourteenth floor has been planned for the medical library. A garage sufficient to accommodate both tenants and clientele has been built in connection with the building so that one can drive directly into the garage, leave his car and enter the elevator lobby. The building is on high ground just outside the congested area, and affords an unexcelled view of the surrounding community and the ocean.—*J.A.M.A.*, March 12, 1927.

Colorado

Dr. Banzhaf Addresses State Dentists: Henry L. Banzhaf, President of the American Dental Association, addressed the dentists of Denver, March 16, on the subject of cooperation between the medical and dental professions. He also spoke on dental education. March 17, he spoke before the Colorado Springs Dental Society on the subject of preventive dentistry.

Connecticut

Annual State Meeting: The sixty-third annual meeting of the Connecticut State Dental Association was held in New London, April 28-30. The literary program was as follows: "Office Efficiency," by John F. Barton, Hartford; "Place of Oral Hygiene in the School Curriculum," by C. J. Hollister, Harrisburg, Pa.; "How to Control Dental and Periodontal Diseases," by Paul R. Stillman, New York City; "Habits (Influence on Malocclusion)," by Albert W. Crosby, New Haven; symposium on "Children's Dentistry," by Drs. Bödecker, Delabarre, Sullivan, Cross and Hyatt. E. V. McCollum spoke on Friday evening, on "What Makes Good Teeth."

Illinois

Dr. Bloodgood Addresses Chicago Society: The April meeting of the Chicago Dental Society was addressed by Joseph Colt Bloodgood, Baltimore, Md., on the subject of "Cancer of the Mouth." About 400 members and guests were in attendance at the lecture, which was preceded by a dinner and election of officers. A male quartet furnished music.

Chicago Dental Society Elects Officers: The newly elected officers of the Chicago Dental Society are: president, Frank G. Conklin; vice-president, Harris W. McClain; secretary, Hugo G. Fisher; treasurer, I. B. Clendenen.

Kentucky

State Association Meets: The Kentucky State Dental Association held its fifty-seventh annual meeting, April 5-7, at Louisville. In addition to an extensive program of clinics, the following papers were read: "Management of Children," by Leonard F. Pogue, Nashville, Tenn.; "The Problem of Approximal Decay in Molar and Bicuspid Teeth," by Arthur G. Smith, Peoria, Ill.; "A Full Denture Technic Embodying Simple and Definite Principles," by O. M. Dresen, Milwaukee, Wis., and "Oral Hygiene," by George Colvin, Louisville.

Dr. O'Rourke Head of Dental School: John T. O'Rourke, of Louisville, professor of dental pathology and dental therapeutics in the University of Louisville, has been made dean of the College of Dentistry, of which he has been acting dean since the death of the late Henry B. Tileston.

State Society Elects Officers: At the fifty-eighth annual meeting of the Kentucky State Dental Association, April 6, the following were elected officers for the ensuing year: president, Guy K. Clark, Russellville; vice-president, George H. Means, Louisville.

Maryland

Baltimore City Society Meets: The Baltimore City Dental Society met, April 11, and was addressed by Horace M. Davis, Baltimore, on "The Necessity for Alveolar Resection in Certain Cases to Secure Better Prosthetic Restoration," and by G. W. Gaver, Baltimore, on "Surgical Preparations of the Mouth for Dentures." The two papers were discussed by Alexander H. Patterson and J. S. Hopkins.

New York

Dental Clinic for Young Children: A preventive dentistry clinic has recently been organized at the New York University College of Dentistry, under the direction of Thaddeus P. Hyatt and Frederick L. Stanton, at which only children between the ages of 18 months and 6 years will be received.

Fifth District Society Elects Officers: At the recent annual meeting of the Fifth District Dental Society, the following were elected officers for the coming year: president, Charles M. Craner, Syracuse; vice-president, H. M. Clapp, Utica; secretary, I. J. Silverman, Syracuse; treasurer, Fred A. Ford, Syracuse.

State Society Meeting: The fifty-ninth annual meeting of the Dental Society of the State of New York was held, May 18-20, at the Hotel Statler, Buffalo. The following essayists took part in the literary program: Albert L. LeGro, Detroit, Mich., who spoke on "Renaissance of Dental Ceramics;" C. F. Bödecker, New York City, on "The Report of the Committee on Scientific Research;" T. B. Hartzell, Minneapolis, Minn., on "The Fundamental Reasons for the Universal Failure to Bring About Permanent Cure of Pyorrhea;" Alexander H. Paterson, Baltimore, Md., on "The Use of the Face Bow in Full Denture Construction;" William A Jaquette, Philadelphia, Pa., on "Optimal Dental Health;" E. Helen Owens, D. H., on "The Future Dental Hygienist;" and Alfred C. Fones, Bridgeport, Conn., on "Consideration of Efforts for Prevention." Friday, May 20, was given over to the clinic program, O. DeForest Davis, Minneapolis, conducting the afternoon clinic on "The Modern Fixed Bridge, Its Construction and Application."

North Carolina

State Society Elects Officers: At the recent meeting of the North Carolina State Dental Society, the following were elected officers for the ensuing year: president, E. B. Howle, Raleigh; president-elect, I. R. Self, Lincolnton; vice-president, S. B. Bivins, Charlotte; secretary-treasurer, D. F. Keel, Greensboro. The annual meeting, the fifty-third, was attended by 375 members.

OHIO

Cleveland Society Elects Officers: At the annual meeting for the selection of officers of the Cleveland Dental Society, the following were elected: president-elect, J. A Loughry; secretary, T. J. Hill; treasurer, C. J. Stark.

Corydon-Palmer Society Meets: The Corydon-Palmer Dental Society met, May 12, 1927, at the Ohio Hotel, Youngstown. The essayists of the day were J. M. Oelschlager, Cleveland, who spoke on "The Various Uses of Porcelain," and U. G. Rickert, Ann Arbor, whose subject was "The Significance and Insignificance of Focal Infection in the Practice of Dentistry." Dr. Rickert spoke in the evening on "The Practical Measures for the Management of the Pulp Involved Teeth with Our Present Conception."

SOUTH DAKOTA

State Society Meets: The forty-fifth annual meeting of the South Dakota State Dental Society was held in Sioux Falls, May 9-11. Among the essayists were R. E. McBoyle, Chicago; Russell M. Wilder, Rochester, Minn.; R. W. Tench, New York City; R. O. Schlosser, Chicago; and W. M. Storey, Madison, Wis.

VIRGINIA

State Society Meets: The Virginia State Dental Association met, May 9-11, at the Hotel Cavalier, Virginia Beach. J. Russell Mitchell, Atlanta, spoke on "Bridgework, Using Vital Teeth as Abutments;" Oren A. Oliver, Nashville, Tenn., on "Orthodontia for the General Practitioner;" U. G. Rickert, Ann Arbor, Mich., on "The Treatment of Pulpless Teeth;" F. M. Hight, Houston, Texas, on "Prosthetic Dentistry; Gabriel Tucker (Chevalier Jackson Bronschoscopic Clinic), Philadelphia, on "Bronschoscopic and Esophagoscopic Cases of Dental Interest;" Chalmers J. Lyons, Ann Arbor, Mich., on "Indications and Contraindications for Removal of Impacted and Unerupted Teeth; George Wood Clapp, New York City, on "Some Fundamentals in Preventive Dentistry;" Richard C. Walden, Richmond, on "Pathological Occlusion—Its Relation to Periodontal Disease;" W. M. Robey, Charlotte, N. C., on "Essentials in the Production of Good X-Ray Films;" and A. J. Cramp (M.D.), Chicago, on "The Medical Profession's Fight Against Commercialized Therapeutics."

FOREIGN

Dental Society of Western Canada: The Dental Society of Western Canada met in Edmonton, Alberta, May 25-27, at the Macdonald Hotel. The chief clinicians were F. F. Molt, Chicago, who spoke on "Oral Surgery, Mouth Preparation and Radiographic Interpretation;" R. R. Gillis, Hammond, Ind., on "Full Denture Difficulties;" Fred J. Conboy, Toronto, on "Ethics, Economics, Practice Building, Etc.;" and W. I. Ferrier, Seattle, Wash., on "Indication for and Practical Demonstrations of Gold Foil Insertions."

Dental Progress in the Near East: At the first dental conference ever held in the Near East, at the Dental School of the American University of Beirut, in Syria, resolutions were passed that more time be given to the subjects of preventive dentistry and mouth hygiene in the dental curriculum. Work among the children of the community is to be undertaken, under the supervision of the university, and the attention of the government officials is to be directed to the need for dental care among the children of the community.

GENERAL

Dr. Potter Given Legion of Honor: Membership in the French Legion of Honor has been bestowed upon Dr. William Henry Potter, of Boston, Mass., professor of Operative Dentistry at Harvard University, it has been learned in Paris. The decoration came through the French ambassador to Washington and was given in recognition of Dr. Potter's services in the World War. Dr. Potter was dental surgeon at the American Ambulance Hospital at Neuilly for three months, during 1914 and 1915. Later he was made first lieutenant in the Dental Corps of the U. S. Army. He was also a member of the U. S. Base Hospital No. 5, and served in British Hospitals, and later as instructor at the Army Sanitary School at Langres, France. He returned to the United States in April 1919, being promoted to major and to lieutenant colonel. Dr. Potter is a member of the American Academy of Dental Science, Massachusetts, and a number of other dental organizations. He is an alumnus of Harvard and since 1904 has been connected with the faculty at Harvard Dental School.—*Paris Edition, New York Herald*, Feb. 23, 1927.

Eastman Gives Fund for London Clinic: Mr. George Eastman, donor of the Rochester Dental Dispensary, Rochester, N. Y., has contributed $1,500,000 for the establishment of a similar clinic in London, in association with the royal free hospital.

Tablet to Memory of Robert R. Proctor: A tablet was recently placed on the Berry School Building, Mt. Berry, Ga., by Dr. Charles M. Proctor, Boston, in memory of Robert Rarsbeck Proctor, his son, in whose memory the dental clinic held in the Berry School was also established. The tablet reads: "In Loving Memory of Robert Rarsbeck Proctor, 1905-1924. This dental clinic is founded by his parents, Doctor and Mrs. Charles M. Proctor, to realize in full fruition lasting and valued service to youthful lives such as his life promised but had not had opportunity to achieve. January, 1926." The Berry School has about 750 students, mountaineers who would otherwise have no opportunity for education.

Army

Dental Corps: Capt. O. J. Christiansen's orders amended as follows: Granted 2 months 18 days' leave terminating in time to sail for Honolulu June 9.

Capt. W. C. Caldwell relieved Walter Reed General Hospital, ordered Canal Zone, sailing from New York July 20.

Capt. R. C. Hughes assigned student 1927-'28 course at Army dental school upon completion foreign service.—*Army & Navy Register*, Feb. 19, 1927.

Dental Corps: Lieut. Col. A. R. White, Fitzsimons General Hospital, ordered before Army retiring board, 7th C. A.

Capt. H. A. Hale granted 2 months' leave from March 10.

Capt. C. R. Hughes assigned Langley Field upon completion foreign service; previous orders revoked.

Capt. Boyd L. Smith, assigned to duty at the Military Academy instead of Fort Douglas upon completion of foreign service.

Capt. William C. Webb, Jr., relieved Military Academy, assigned Fort Douglas, sailing from New York September 9.—*Army & Navy Register*, March 5, 1927.

Dental Corps—Maj. R. McK. McDowell assigned New York G. I. D., upon completion of foreign service.

Maj. H. E. Smalley relieved office surgeon general, assigned Philippines, sailing July 27.

Capt. W. C. Caldwell granted 1 month 18 days' leave, effective May 31.—*Army & Navy Register*, March 19, 1927.

Dental Corps: Maj. William S. Rice relieved Walter Reed General Hospital and will report as commandant Army dental school.—*Army & Navy Register*, April 2, 1927.

Deaths

Anderson, Frank W., Santa Rosa, Calif.; College of Dentistry, University of California, 1900; died, March 14, suddenly, of heart disease, aged 48.

Baldwin, Cornelius V., Los Angeles, Calif.; died, January 31; aged 93.

Brown, E. Fred, Chicago, Ill.; died suddenly, February 11, of heart disease.

Cheyney, J. W., Glenside, Calif.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1898; died March 9, of pneumonia; aged 50.

Funkhouser, Albert Taylor, Evansville, Ind.; Indiana University School of Dentistry, 1906; died, March 19; aged 43.

Gage, E. H., Weyauwega, Wis.; Indiana University School of Dentistry, 1892; died, March 2, at Green Bay, aged 80.

Goebel, Robert, Lincoln, Ill.; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1883; died, March 6, at the Deaconess Hospital, aged 67. Dr. Goebel had been ill for a year.

Harrold, Frank W., Elwood, Ind.; Indiana University School of Dentistry, 1905; died suddenly, February 17, of heart disease; aged 53.

Hart, Julian B., New York City; College of Dental and Oral Surgery of New York, 1914; died, March 13, of tuberculosis; aged 33. Dr. Hart was a captain in the Dental Reserve Corps.

Hartenstein, Alfred J., Louisville, Ky.; died, February 24, of pneumonia; aged 51.

Haynes, Delos, Owensboro, Ky.; Vanderbilt University, School of Dentistry, 1886; died, December 21, a suicide, after a severe attack of influenza from which he had not fully recovered; aged 70.

Hughes, Samuel J., Punxsutawney, Pa.; died, February 3; aged 79.

Announcements

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Academy of Periodontology, October 20-22, 1927, Detroit, Michigan.

American Dental Assistants Association, October 24, 1927, Detroit, Michigan.

American Dental Hygienists Association, October 24-28, 1927, Detroit, Michigan.

American Dental Association, October 24-28, 1927, Detroit, Michigan.

American Society of Oral Surgeons and Exodontists, October 21-22, 1927, Detroit, Michigan.

American Dental Society of Europe, August 1-3, 1927, Paris.

European Orthodontological Society, July 21-22, 1927, London, England.

International Dental Federation, August 6-9, 1927, Copenhagen.

Sixth Australian Dental Congress, August 22-27, 1927, Melbourne, Australia.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

June (1927)

Colorado, at Colorado Springs (15-18).
Georgia, at Albany (15-17).
Idaho, at Pocatello (13-15).
Maine, at Belgrade Lakes (21-23).
Mississippi, at Gulfport (16-18).
New Hampshire, at Plymouth (8-10).
New Mexico, at Roswell.
Oregon, at Portland (20-23).
Wyoming, at Thermopolis (20-21).

July (1927)

Porto Rico, at San Juan.
Wisconsin, at Milwaukee (12-14).

October (1927)

Florida, at St. Petersburg.

December (1927)

Ohio, at Cleveland (2-4).

February (1928)

Minnesota, at Minneapolis (Feb. 29-March 2).

March (1928)

Montana, at Missoula (29-31).

April (1928)

California, at Stockton (9-12).

*Announcements must be received by the ninth of the month in order to be published in the forthcoming issue of THE JOURNAL.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 27, 1927. Secretary-Treasurer, E. W. Patton, 725 First National Bank Building, Birmingham, Alabama.

Arkansas, at Little Rock, June 27-July 1, 1927. Secretary, W. E. Hutchison, Dermott, Arkansas.

Connecticut, at Hartford, June 23-25, 1927. Recorder, A. B. Holmes, Waterbury, Connecticut.

Delaware, at Wilmington, June 15-16, 1927. Secretary, W. S. P. Combs, Middleton, Delaware.

District of Columbia, at Georgetown University Dental School, June 14-18, 1927. Secretary-Treasurer, C. Willard Camalier, Medical Science Building, Washington, D. C.

Florida, at Jacksonville, June 16, 1927. Secretary, R. P. Taylor.

Indiana, at Indianapolis, June 13, 1927. Secretary, J. M. Hale, Mt. Vernon, Indiana.

Iowa, at Iowa City, May 31-June 3, 1927. Director, H. W. Grefe.

Kansas, at Wichita, June 13, 1927. Secretary, George E. Burket, Kingman, Kansas.

Kentucky, at Louisville, June 17, 1927. Secretary, J. H. Baldwin, 980 Francis Building, Louisville, Kentucky.

Louisiana, at New Orleans, June 9, 1927. Secretary-Treasurer, Henry J. Feltus, 410 Roumain Building, Baton Rouge, Louisiana.

Maine, at Augusta, June 23-25, 1927. Secretary, G. W. MacKay, Millinocket, Maine.

Maryland, at Baltimore, June 1-3, 1927. Secretary, T. L. McCarriar, 1822 N. Charles Street, Baltimore, Maryland.

Massachusetts, at Boston, June 14-17, 1927. Secretary, W. Henry Grant.

Michigan, at Ann Arbor, June 13-18, 1927. Secretary, J. W. Lyons, 617-21 Dwight Building, Jackson, Michigan.

Minnesota, at Minneapolis, June 16-26, 1927. Secretary, F. E. Cobb, 601 Donaldson Building, Minneapolis, Minnesota.

Mississippi, at Jackson, June 21, 1927. Secretary, Reuel May, Jackson, Mississippi.

Missouri, at St. Louis, June 8-11, 1927. Secretary, George E. Haigh, Central Trust Building, Jefferson City, Missouri.

New Jersey, at Trenton, June 27-July 1, 1927. Secretary, John W. Forsyth, 148 W. State St., Trenton, N. J.

New Mexico, at Roswell, June 16-18, 1927. Secretary, J. J. Clarke, Artesia, New Mexico.

North Carolina, at Raleigh, June 20, 1927. Secretary, H. O. Lineberger, Raleigh, North Carolina.

Ohio, at Columbus, June 27-July 2, 1927. Secretary, Ray R. Smith, 327 E. State Street, Columbus, Ohio.

Oklahoma, at Oklahoma City, June 20-23, 1927. Secretary-Treasurer, Charles A. Hess, Idabel, Oklahoma.

Pennsylvania, at Philadelphia and Pittsburgh, June 22-25, 1927. Secretary, Alexander H. Reynolds, 4630 Chester Avenue, Philadelphia, Pennsylvania.

Rhode Island, at Providence, June 28-30, 1927. Secretary, Albert L. Midgley, 1108 Union Trust Building, Providence, Rhode Island.

South Dakota, at Sioux Falls, June 27, 1927. Secretary, G. G. Kimball, Mitchell, South Dakota.

Tennessee, at Memphis, June 20, 1927. Secretary-Treasurer, F. W. Meacham, 911 Hamilton National Bank Building, Chattanooga, Tennessee.

Texas, at Dallas, June 6-9, 1927. Secretary, D. C. Johnson, Atlanta, Texas.

Vermont, at Montpelier, June 27-29, 1927. Secretary, David Manson, Burlington, Vermont.

Virginia, at Richmond, June 14, 1927. Secretary, John M. Hughes, 715 Medical Arts Building, Richmond, Virginia.

West Virginia, at Charleston, June 28, 1927. Secretary, C. H. Neill, 206 Professional Building, Fairmont, West Virginia.

Wisconsin, at Milwaukee, June 13-18, 1927. Secretary, S. F. Donovan, Tomah, Wisconsin.

National Association of Dental Examiners, at Detroit, Michigan, October 22, 1927. Secretary-Treasurer, George L. Powers, Memphis, Tennessee.

MONTANA STATE DENTAL ASSOCIATION

The next annual meeting of the Montana State Dental Association will be held at Missoula, March 29-31, 1928.

J. E. BEUHLER, *Sec'y-Treas.*,
Great Falls, Mont

BOARD OF DENTAL EXAMINERS OF ARKANSAS

The next examination given by the Board of Dental Examiners will be held in Little Rock, June 27-July 1.

W. E. HUTCHISON, *Secretary*,
Dermott, Ark.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

The annual meeting of the Florida State Board of Dental Examiners will be held at Jacksonville, June 16, for the purpose of examining all qualified applicants for license to practice dentistry and oral hygiene in Florida.

R. P. TAYLOR, *Secretary*.

DEPARTMENT OF LITERARY RESEARCH

The announcement of this new department has been met with the most cordial expressions of approval, and a gratifying number of requests for service have been received. Since its advent about three months ago, inquiries and requests for packages have come from every direction; literally, from California to Maine. In all, individuals from twenty-five states have called for service.

Some inquiries have been made relative to the contents of the package libraries. These packages are made up of reprints, magazine clippings, pamphlets and typed excerpts on any requested subject. Articles to be included are not evaluated, from either a literary or a dental standpoint, but in each case an effort is made to send material representative of the various opinions on that subject. In other words, the packages are not limited in any way by the personal viewpoint of the compiler.

Acknowledgment is due the medical and dental journals for their generosity in contributing copies of their magazines for clipping purposes. Without their cooperation, the service would be greatly curtailed. Many medical journals have given issues containing articles pertaining to dentistry, and thirteen dental journals already have given files. The Department and the Association wish to express their appreciation to all these journals.

From time to time, lists will be issued of the various subjects on which package libraries or bibliographies have been compiled. The new books available for lending will also be listed. Suggestions of any kind regarding the service now rendered, or for additional features to be added, will be most welcome. Address the Department of Literary Research, American Dental Association.

LOUISIANA STATE BOARD OF DENTAL EXAMINERS

The annual meeting of the Louisiana State Board of Dental Examiners will be held in New Orleans, Loyola University Dental School, commencing at 8:30 a. m., June 9.

HENRY J. FELTUS, *Sec'y-Treas.*,
410 Roumain Bldg.,
Baton Rouge, La.

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

The Mississippi State Board of Dental Examiners will hold its annual examination beginning the third Tuesday in June (21), at the State Capitol, Jackson.

REUEL MAY, *Secretary*,
Jackson, Miss.

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, beginning promptly at 9 a. m., June 14, 1927. Applicants are required to present a certificate from the state board of education showing that they have had one year of academic education equal to one year of college work. Applications, with fees and photograph, must be filed, complete, ten days before the examination (June 14, 1927). For application blanks and further information, apply to

JOHN M. HUGHES, *Secretary*,
715 Medical Arts Bldg.,
Richmond, Va.

RESOLUTIONS ON THE DEATH OF DR. NOYES

WHEREAS, it has pleased God to call to eternal rest our beloved friend and fellow member, Edmund Noyes, who for more than sixty years administered through his rare skill to the health, happiness and comfort of humanity and through whose intelligent efforts and timely advice dental education and dental society organizations were so well established in Chicago and the West as to prove a real benefit and blessing thereto; therefore, be it

Resolved, that we, the members of the Odontographic Society of Chicago, in our annual meeting assembled, take cognizance of Edmund Noyes' sterling worth as a man of great and good character, as a dentist of exceptionally high literary ability and manipulative skill, as a teacher very serious in his endeavor to raise the standards of those just entering on practice, and as a dental society member very punctilious in the performance of his duties. Edmund Noyes was the modest recipient of so many honors that space or purpose here does not permit of enumeration. (Suffice it to say here that Edmund Noyes was a Fellow of the Oodontographic Society of Chicago.)

We recognize the foregoing facts and sadly realize our great loss; therefore, be it

Resolved, that the secretary of the Odontographic Society be instructed to inscribe in our minute book these resolutions, and send a copy thereof to the family of the deceased and another copy to the professional journals for publication.

ELMORE W. ELLIOT
C. F. B. STOWELL
Committee

BOOK REVIEWS

Orthodontics, An Historical Review of Its Origin and Evolution, Including an Extensive Bibliography of Orthodontic Literature Up to the Time of Specialization. By Bernard Wolf Weinberger, D.D.S., New York City, Librarian, First District Dental Society of the State of New York and Advisory Librarian (Dental Department), New York Academy of Medicine. Member Fédération Dentaire Internationale and various dental and orthodontic societies. Illustrated. Issued in two volumes, 1011 pages. Price $25.00. Published by the C. V. Mosby Company, St. Louis, Mo.

The author of this work has evidently given unlimited time to its preparation. He deals not only with orthodontic history but goes quite extensively into general dental history. And he considers only that part of the history of orthodontia up to the time of specalization. He divides his work into five periods—the period up to 1530, the next period 1728 (the time of Fauchard), the next 1839, the time of Harris, the next 1870, and the next 1900. This work is the most fascinating that we have picked up in many a day, and it is difficult to lay it aside when the volumes are once opened. It gives one a vivid glimpse of the dentistry of early days, and Dr. Weinberger has added to the accuracy of his presentation by using almost exclusively extracts from various authors who have written on the different subjects. Thus, the quaintness of some of the early writers has been perfectly preserved, and we are given a faithful portrayal of the development, not only of orthodontia itself but also of many other phases of dental practice. An attractive feature of the work is the presentation of many of the portraits of the pioneers of dentistry, which adds to the interest, and tempts one to return to the volumes more than once. A very extensive bibliography has been prepared of nearly 80 pages, and also an index of proper names, all of which contributes to the completeness of the work. These volumes should be in every dental library.

Clinics, Hospitals and Health Centers. By Michael M. Davis, Ph.D., in collaboration with other staff members of the Committee on Dispensary Development of the United Hospital Fund of New York. 546 pages. Published by Harper & Brothers, New York and London.

The author truly says in his introduction: "In a subject involving so much detail, it is difficult to decide what to include and what to omit." And yet it may be said with all conservatism that the present volume deals quite comprehensively with the most signficant features of the subject, and gives the reader an intelligent idea as to what is being done in this field.

The chapter on "Dental Clinics" is contributed by Clare Terwilliger, A.B., R.N.,

which insures a careful and intelligent presentation of the subject. She deals with such subtopics as "Types of Dental Service," "Dental Personnel," "Community Dental Needs," "Dental Policy for Children," "Financial Policy," "Organization," etc. In treating of "Community Dental Service in Action," she gives, in a few words, a most entertaining insight into the various activities in operation today, and we would strongly commend this chapter to the attention of our readers. In fact, it would do no harm for dentists to study this book from beginning to end.

The Teeth and Health. By J. Sim Wallace, D.Sc., M.D., L.D.S., Lecturer on Preventive Dentistry, King's College Hospital; formerly dental surgeon and lecturer on dental surgery and pathology, London Hospital. 214 pages. Price 3s, 6d, net. Published by Faber and Gwyer, London, England.

This book, one of the Modern Health Books, edited by Prof. D. Fraser Harris, M.D., embodies the well known theories of Dr. Wallace on diet and its relation to the teeth and health. Dr. Wallace has written extensively for years on this subject, and therefore he speaks with some authority. In the main, his theories seem to be well founded, but in this country, where our dietitians have been more and more emphasizing the value of milk as a diet, it is rather disturbing to read: "It is quite obvious that throughout the whole animal kingdom milk never is, and was never intended to be, natural food after weaning;" which leads the average uninformed reader to utter the plaintive cry: "When, oh when, shall our scientific investigators on diet get together sufficiently to recommend a sane and simple diet which may safely be followed by the great mass of the people who acknowledge that they do not yet know what they should eat?"

Harelip and Cleft Palate. History, Etiology, Development, Anatomy, Physiology, Types, Surgical and Nonsurgical Treatment and Report of Cases. By Matthew N. Federspiel, B.Sc., D.D.S., M.D., F.A.C.S., F.A.C.D., professor of oral surgery, Marquette University, ex-professor of orthodontics, Marquette University, former president of the American Society of Orthodontists, oral surgeon, Milwaukee Hospital, Marquette Hospital and Federspiel Dental Polyclinic. With illustrations by L. Kerschbawmer, M.D. 200 pages. Price $5.00. Published by the C. V. Mosby Company, St. Louis, Mo.

The author of this book is first to be congratulated on the broad attitude he takes with reference to the management of harelip and cleft palate. In the preface, after discussing the various means of treating these cases—surgically and by way of prosthesis—he says: "Many cleft palate cases that fail to respond to plastic surgery, on account of shortage of tissue, can be greatly improved with the insertion of artificial dentures and palate that give the patient a remarkable improvement which surgery alone fails to give. Therefore, a knowledge of the principles and technic in surgery, combined with the principles and technic in orthodontics and prosthetics gives the oral surgeon the judgment which is so necessary for the correction of palate and lip clefts, when complicated with dentofacial deformities, irregularities of the teeth, and malrelation of the dental arches."

Dr. Federspiel's liberal attitude toward other authors and surgeons is most commendable, and worthy of emulation by other writers. He says: "The author is not unmindful of the splendid work that has been done, and is being done, by surgeons doing cleft palate operations. Friendly cooperation, kindly instruction and advice, the spirit of give and take in consultation, in private practice and in free clinics—all contribute to the progress of scientific investigation and study which formulate and mold the opinion of men and stimulate them to a greater success and future achievement."

If all men would only display toward each other a similar spirit of liberality the progress of surgery and science would be more certain, and any book written with this as its *motif* must appeal to all fair minded readers.

As to the technical part of the work, the reviewer does not feel qualified to express an opinion, but assuredly the illustrations tell a very vivid story, and any operator who is doing this work will have no trouble in following the author in his various technical procedures. The mechanical part of the book is well done, and the publishers are to be congratulated.